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(U) ARMY TANK-AUTOMOTIVE COMMAND WARREN MI 1982

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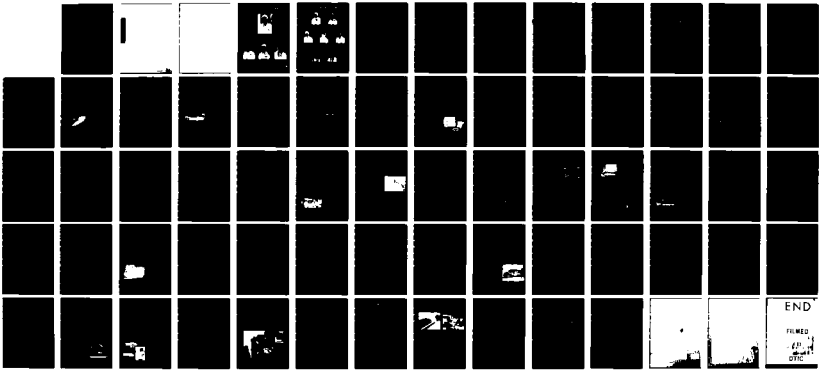

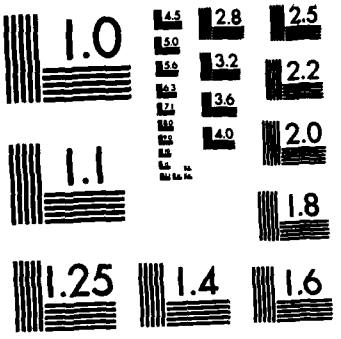

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MANAGEMENT

ORGANIZATION ASSIGNMENTS/RESPONSIBILITIES

TANK-AUTOMOTIVE CONCEPTS LABORATORY

The Tank-Automotive Concepts Laboratory (TACL) was established to focus mangement attention on advanced vehicle development program, initiatives, and survivability. TACL operated during FY82 with an organization structure consisting of an Exploratory Development Division, a Survivability Research Division, and a Program Control Office.

The Exploratory Development Division is responsible for advanced military vehicle system research, concept feasibility studies, and advanced engineering design programs, including the development and maintenance of tank-automotive long-range technology/ methodology programs.

The Survivability Research Division is responsible for basic and applied research directed toward new and improved vehicle performance, operational capability, survivability including research leading to new principles for sensing and measuring vehicle signatures and electromagnetic interference, counter-surveillance, signature reduction, electronic warfare countermeasures for military vehicle systems, and for exploratory development programs in ground mobility.

TANK-AUTOMOTIVE SYSTEMS LABORATORY

The Tank-Automotive Systems Laboratory (TASL) was organized to consolidate research, development, engineering efforts, and conduct of performance-related product-improvement programs and consists of three divisions (Combat Systems, Tactical Wheeled Vehicle Systems-with two divisions, and Propulsion Systems) and one supporting office (Program Control).

The Combat Systems Division conducts advanced development and engineering development for combat vehicles through first production and initial fielding. This division provides technical support, world-wide, to planners, producers and users of combat vehicles, including product improvement programs. In the area of vehicle subsystems and components, the Combat Systems Division directs research on potential track materials, and executes exploratory and advanced development of armor, track and suspension, combustion fire detection and suppression, and composite materials for combat vehicle applications. Also, it executes an integration role for both fire control and fire survivability programs for ground combat vehicles. It also directs and coordinates the manufacturing methods and technology, and Military Adapted Commercial Item Programs for ground vehicles. The Weapons System Managers for the Field Artillery Ammunition Supply Vehicle and the Small Unit Support are assigned here.

During FY81, organizational changes were implemented to form a Tactical Wheeled Vehicle Systems Division which is the parent organization of two subdivisions. The sudden increase in tactical wheeled vehicle workload, and accelerated schedules on the M939 5-ton, CUCV, HMMWV and 10-Ton M.A.N. truck programs resulted in the establishment, on 1 July 81, of the Tactical Wheeled Vehicle Division. It is structured to provide intensive management of the aforementioned truck programs, as well as mission responsibilities and resources of the Tactical Wheeled Vehicle Management Office. This office provides improved control and cost effective management of the Army's tactical fleet throughtout the life cycle. This division is responsible for vehicle development, engineering development, and production engineering and management of performance-related product-improvement programs for tactical wheeled vehicles.

The Tactical Systems Support Division manages advanced military tactical wheeled vehicle systems, engineering design and development programs, including improved

ORGANIZATION ASSIGNMENTS/RESPONSIBILITIES

methods of assessing the effectiveness of future transport, and tactical and special vehicle designs. It is involved in managing the tactical vehicle systems design, development and engineering programs through first production and initial fielding of a number of tactical support wheeled vehicles (e.g., Semi-trailers for GLCM, PATRIOT and MLRS) by providing the necessary technical direction and resources essential to the accomplishment of the maintenance, supply, procurement, production and the industrial mobilization requirements for support vehicles. In addition, it is responsible for planning, directing and conducting research, development and engineering of components such as materials, wheels, mechanical and electrical devices, tires, special automotive kits and environmental systems for tactical, automotive vehicles.

Propulsion Systems Division responsibilities include research, development, qualification, and integration of combat and tactical vehicle engines, transmissions, air cleaners, cooling systems, diagnostic and prognostic equipment, and electrical power distribution and management systems. Due to the increasing application of electronics in military ground vehicles and resulting electrical system sophistication, an added responsibility has been included called VETRONICS. This program will account for the integration of all electrical/electronic/sensing systems into military vehicles. It also performs the compilation and exchange of data with foreign and U.S.-based industries for the above activities.

Program Control Office provides budget and program support services to the Systems Laboratory, and administers the TACOM cost reduction, military adaptation of commercial items, and manufacturing methods and technology program accounts.

An ancillary office, the Computer Management and Application Research Office, consolidates TACOM's computer assets for control and function priorities.

SYSTEM & TECHNOLOGY PLANNING OFFICE (STPO)

In FY82, the STPO continued as the R&D Center's mid-and-long range planning element. This office establishes future technological development goals through a variety of means. These include the DA-wide Armored Combat Vehicle Science and Technology Base Development Program; systems planning activities in conjunction with TRADOC; international data exchange agreements with NATO and our other allies; and extensive interchange of information with industry through independent research and development and other initiatives.

During the year, the office also became the Command's link with the High Technology Light Division activity at Ft. Lewis, Washington. This involved a major redirection of assets to address properly this highly visible activity and to provide it with the intensive management required to respond to rapidly evolving short term requirements. This commitment is expected to expand in the coming year as requirements are solidified.

MANAGEMENT

ORGANIZATION ASSIGNMENTS/RESPONSIBILITIES

VEHICLE NBC PROTECTION

The Development Project Office for Vehicle NBC Protection was chartered in 1979 by DARCOM Regulation 1-10 to plan, intensively manage, and direct the expedited development of Hybrid Collective Protection Equipment (HCPE) for selected combat vehicles.

During Fiscal Year 1982, DARCOM tasked TACOM to insure that programs for NBC/cooling are part of a unified plan. This assignment established a single manager responsbiliity for armored vehicle NBC/cooling efforts. The responsibility covers all aspects of NBC/cooling, including oversight and guidance on component development and soldier interface as well as the standard TACOM mission of systems integration. Additionally, a TACOM R&D Center charter established a Technical Area Manage (TAM) for Life Support. Life support is defined as that area of human factors which applies scientific knowledge to items which require special attention to or provisions for personnel health, safety, protection, sustenance, escape, survival and recovery. This Life Support TAM is to provide overall direction and coordination of all life support matters related to TACOM vehicles, present and future. The TAM is further responsible for coordinating life support plans and activities within the development community and at higher Army levels.

This Development Project Office also monitors the resolution of crew performance degradation imposed by NBC protection measures.

TACTICAL WHEELED VEHICLE DIVISION

The Tactical Wheeled Vehicle Division is responsible for vehicle development, engineering development and production engineering and management of performance related product improvement programs for selected tactical wheeled vehicles. The Division provides itensive management to the M939-Series 5-ton truck program, CUCV, HMMWV, F.A.V., and 10 ton M.A.N. truck programs. The Division has a system manager for each vehicle program who is responsible for overall management of that particular program. The mission responsibilities of the Tactical Wheeled Vehicle Management Office are also contained within this Division.

TACTICAL WHEELED VEHICLE MANAGEMENT OFFICE

The Tactical Wheeled Vehicle Management Office's (TWVMO) mission is to develop and maintain overall fleet acquisition, product improvement, maintenance and replacement planning to provide a balanced, economical and effective tactical vehicle fleet. TWVMO also coordinates interchange requirements from other commands and develops interdepartment requests from other services. TWVMO is involved in coordinating the procurement planning for the budget process. Program planning also is on-going for a new vehicle between the 1¼- ton to 5-ton class: The Medium Tactical Truck (MTT), which will replace the 2-½ ton truck. TWVMO is also responsible for Tactical Wheeled Vehicle Studies.

MANAGEMENT

ORGANIZATION ASSIGNMENTS/RESPONSIBILITIES

TANK DEVELOPMENT OFFICE

The Tank Development Office focuses management attention on requirements issues affecting the combat vehicle technology base. It assists the Commander, TACOM R&D Center, in meeting user needs relating to the design or development of new or improved ground combat systems.

During FY82, the Tank Development Office was involved with the Future Close Combat Vehicle Concept Study; Combat Vehicle Science and Technology Base Program; Test Beds; Armored Support Vehicles; Counter-Obstacle and Counter-Mine Vehicle Systems; Military Motorcycle and Helmet; and Ammunition Packaging and Battlefield Handling Concepts. Also, the office was prominent in management issues relating to the development and production of track components, power trains, life support and survivability sub-systems, high visibility hatches, system product improvements and system integration.

FIELD ARTILLERY AMMUNITION SUPPORT VEHICLE (FAASV) WEAPON SYSTEM MANAGER'S (WSM) OFFICE

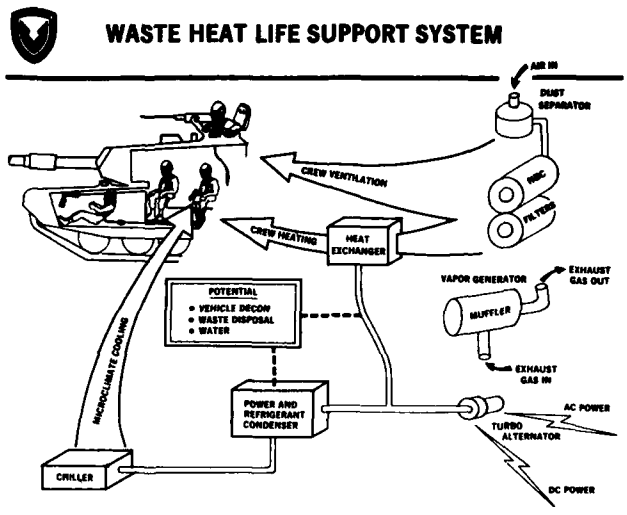
The FAASV Weapon System Manager Charter was renewed on 26 April 82. The first two Full Scale Engineering Development (FSED) prototype vehicles were designed, fabricated and delivered by November 1982. The FAASV prototype vehicles successfully completed the Prototype Qualification Test-Government and Operational Test II in April 1982. The production contract Procurement Request (PR) package was forwarded to the Procurement and Production Directorate, TACOM, during September 1982. The Request for Proposal (RFP) is scheduled for release during October 1982 with contract award scheduled for March 1983.

Funding resources are adquate and there are no known shortfalls or problems that will jeopardize the scheduled November 1984 FAASV Program IOC date.

WASTE ENGINE HEAT ENERGY CONVERSION

Energy needed to support NBC filtration/protection and to provide adequate cooling places considerable demands on combat vehicle power systems. To improve NBC/cooling systems integration, a study was initiated to investigate whether the engine exhaust could provide enough energy to power NBC filtration systems and cool the vehicle crew. Results of the study indicate that by replacing the main engine muffler with a vapor generator power converter, up to 10 kW of usable power can be generated. At the same time, without changing the engine system, the vehicle can provide 7,500 Btu/hr crew cooling capacity, electrical power to run a 300 CFM collective protection filter unit, and up to 2.0 kW of electrical power for other vehicle system needs.

This system also will provide up to approximately 100,000 Btu/hr of crew/compartment heating capability in winter and replace the current fuel burning personnel heater. The waste heat system also has the potential of providing a hot air chemical agent decontamination capability and human waste pyrolysis during prolonged missions. One unique feature of the vapor generator is that it can provide rated power output with the engine off by using an integral fuel burner. The advantage of this is that all NBC air filtration/protection, crew cooling/heating, and auxiliary electrical power is now possible while the engine is off. The current development plan is targeted toward achieving a brassboard model system/demonstration during FY83. The system is being sized for the M3 vehicle.



FLAME CUTTING OF HEAVY ARMOR STEEL

Cut quality and dimensional tolerance of flame cut armor steel components are subjects of the manufacturing methods and technology program begun by TACOM in Jul 82 in support of M1 tank production. General Dynamics and the Army Materials and Mechanics Research Center will apply adaptive control to both the gas flame and torch position. This control will improve surface finish and compensate for thermally induced motion during the cutting process. This process is now used at Lima Army Tank Plant.

ADVANCED NBC FILTERING SYSTEM

The Advanced Filtering Systems Project was initiated in FY81. The project involved conducting parametric studies leading to an alternative to the time-honored charcoal-type filtering system. The principal efforts reduced shortcomings to the present combat vehicle NBC air filtration systems by:

- o Providing reusable chemical agent/gas filters (regeneration)
- o Increasing filter life
- o Avoiding gas filter poisoning

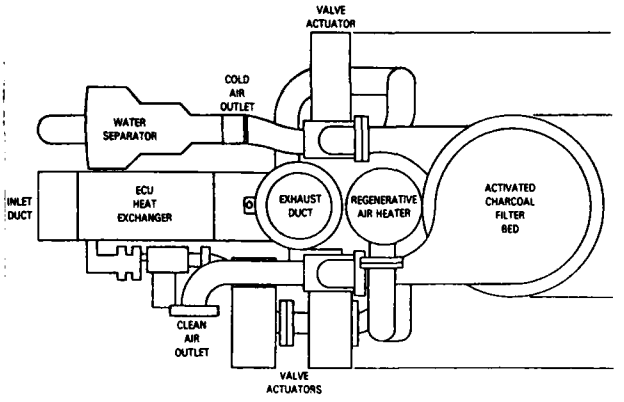
Five categories of air purification methods have been considered:

- o Regenerative absorption
- o Corona discharge
- o Catalytic air
- o Regeneration recycle life support (NASA type)
- o Combination of two or more of the above

The regenerative absorption air purification method was selected as the lowest risk method in the 100 to 200 CFM air flow range. A prototype has been fabricated with an auxiliary 10 kw turbine engine as the prime energy and heat source for regenerating the charcoal bed and operating the system. The system uses two charcoal gas flters in a flip-flop mode. While one filter is being desorbed of contaminants by high heat, the other gas filter is utilized to filter the air for vehicle crew needs.

As a result of a prior TACOM project with the University of Arizona the feasibility of corona dischar , a parallel development effort ha. been instituted. After extensive eva ion by the advanced filtration cont or, corona discharge technology was ju o be a sufficiently viable alternative for future particulate filtering systems. A third option, catalytic oxidation, is also being investigated. Fabrication of the regenerative gas filtering prototype was completed during FY82 and testing will continue into FY83.

REGENERATIVE AIR PURIFICATION SYSTEM TOP VIEW



NOTEWORTHY TECHNICAL CONTRIBUTIONS

SELF-CLEANING AIR FILTER

High concentration of dust under field conditions and the desire of user units to eliminate frequent and lengthy maintenance procedures provided the program impetus to develop a self-cleaning air filter (SCAF) system to clean engine induction air for the M1 tank and other combat vehicles.

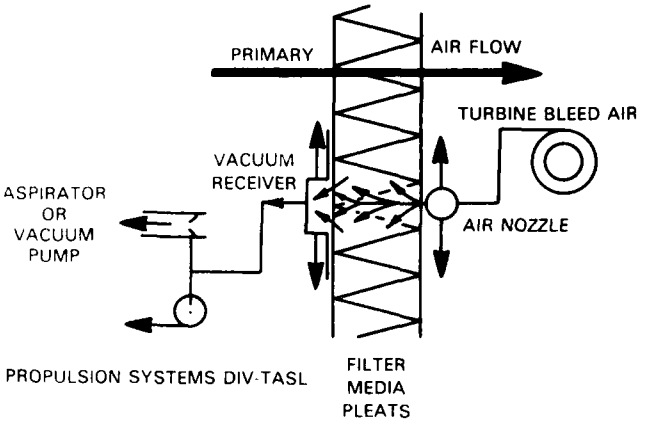
Current military air filter specifications require 99.5 percent efficiency and 20 hours of dust capacity (service life) under laboratory conditons. Under severe field conditions, however, the service life can be reduced to less than two hours.

Goals of the SCAF program are to provide air filtration within the same space and at the same level of efficiency as in existing configurations, while extending service life by a factor of ten.

During FY82, Phase II prototype fabrications were completed. Two prototype systems were installed in turbine engine powered M1s and field tested at Ft. Knox and Yuma Proving Grounds. Results were successful confirming a ten fold increase in filter service life.

In FY83, five SCAF systems will be fabricated and four of them tested in M1 RAM-D vehicles. A sixth assembly will be fabricated for laboratory testing to support field activites and provide a base for running changes as required.

SELF-CLEANING AIR FILTER
BACKFLUSH CLEANING PRINCIPLE



CVX-650 HYDROMECHANICAL TRANSMISSION

Currently in the testing phase, the CVX-650 Transmission Development Program incorporates several improvements over current hydromechanicals which will enable accurate control of the hydromechanical drive characteristics resulting in improved engine fuel efficiency and improved performance.

Two CVX-650 transmission prototypes, fabricated in FY81, have entered an extensive testing phase. One prototype is undergoing simulated durability testing in the laboratory. The other prototype has been installed in a combat vehicle test rig and is currently being tested on a variety of test courses.

Additional durability testing on both prototypes is planned for FY83 along with extensive steering control evaluations.

NOTEWORTHY TECHNICAL CONTRIBUTIONS

FLUDIC DAMPER

The Fluidic Damper Program was established to develop a fluidically controlled, adaptive damper, suitable for the M113 class vehicles that would reduce shock loads to the vehicle in rough terrain, thereby increasing mean miles between failures, mobility, ride quality, gun platform stability, and RAM-D while reducing costs.

Lab testing of two advanced self-contained dampers has been completed; all components functioned correctly.

Prototype fluidic dampers are being fabricated for M113 vehicle evaluation in FY83.

Evaluations of manufacturing techniques and alternate materials are planned in FY83; this will reduce costs of the fluidic jounce valve and other parts unique to the fluidic damper.

ARMY GROUND TURBINE 1500 FUEL ECONOMY PROGRAM

The object of the Army Ground Turbine 1500 Fuel Economy Program primarily has been to reduce the mission fuel consumption.

During FY82, further testing was accomplished to provide additional durability data and to investigate the interchangeability of the new modules with production modules. Durability testing is not completed yet, but the interchangeability testing demonstrated workable compatability between the old and new modules. Durability testing will conclude in early FY84.

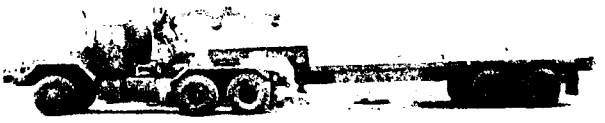
XM974 PATRIOT SUPPORT SEMITRAILER (GMT/LRPT)

In FY82, TACOM provided in-house design, development, and pilot production (14 vehicles) of the XM974-Series Semitrailer, Guided Missile Transporter (GMT) and Large Repair Parts Transporter (LRPT) kits.

The XM974 is a tandem axle, 30,000 lbs. payload semitrailer and is configured for PATRIOT Missile System as a Guided Missile Transporter (M976) or a Large Repair Parts Transporter (M1033) by the addition of conversion kits. The prime mover for the XM974 is the M819A1 5-ton Tractor Wrecker.

During the program's development phase, the semitrailer's gooseneck was modified for improved breakover capability. Additionally, the Large Repair Parts Transporter's material handling pallet was modified for compatibility with the M819A1.

TACOM will continue to support PMO PATRIOT in FY83 with pilot production of 16 vehicles (8 GMT, 8 LRPT) leading to competitive procurement beginning FY84.

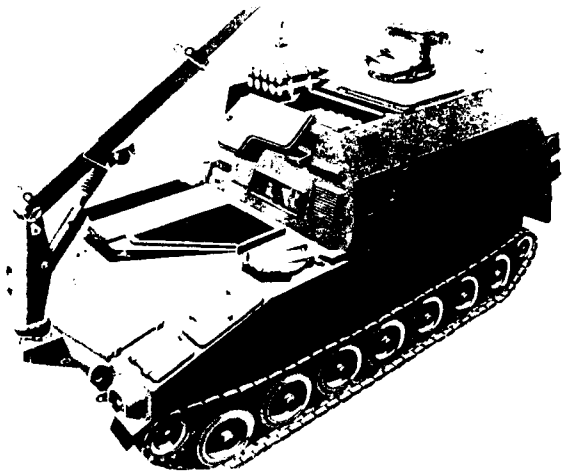


NOTEWORTHY TECHNICAL CONTRIBUTIONS

FIELD ARTILLERY AMMUNITION SUPPORT VEHICLE (FAASV) XM922

The contract for design, fabrication and delivery of five prototype XM992 FAASVs was awarded on 25 March 1981 to BMY Division of Harsco Corp, York, PA. The first two Full-Scale Engineering Development prototype vehicles were designed, fabricated and delivered to Yuma Proving Grounds, AZ, for Prototype Qualification Test-Government testing which was completed in April 1982.

The three remaining FAASV vehicles were delivered during December 1981 to the US Army Field Artillery Board, Ft. Sill, OK, for Operational Test II (OTII). The FAASV OTII tests were also completed during April 1982.



45- 65-TON VEHICLE TRACK

Testing of a fabricated, lightweight, replaceable pad track for the M1 tank track commenced in FY82. Based upon the positive test results, Phase II testing of an improved version of this track will be conducted in FY83.

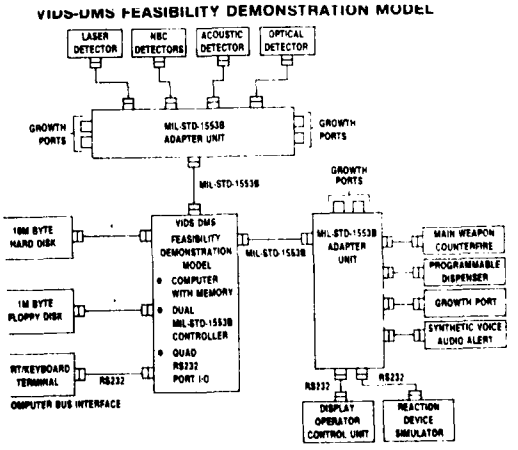
In addition, the application of new materials, such as laminated metals and a metal matrix to tank track, will be investigated.

VEHICLE INTEGRATED DEFENSE SYSTEM (VIDS)

The Tank-Automotive Concepts Laboratory is developing a combat vehicle self-protection system to increase battlefield survivability for future ground-borne combat vehicles. This vehicle integrated defense system (VIDS) incorporates a suite of threat detection devices, countermeasure responses or reactions, display and communications interactions, and threat warning hardware from which the best combination may be selected and used.

The technology basis for this integrated self-protection system is a microprocessor-based processor, identified as the Data Management System (DMS). The DMS is structured to interrogate sensor engagement algorithms based on threat information from a suite of early warning sensors. Threat classification and prioritization are accomplished based upon discrimination analysis of identified threat parameters and multi-disciplined threat characterization.
Optimum countermeasure reactions can either be automatically activated by the Data Management System, or implemented by the vehicle commander, based on artificial intelligence displayed or otherwise communicated to him.

VIDS-DMS FEASIBILITY DEMONSTRATION MODEL



NOTEWORTHY TECHNICAL CONTRIBUTIONS

Significant program achievements include successful field demonstrations of threat warning systems for helicopter threats, a limited Data Management System and several countermeasure responses. A system specification has been completed for a developmental DMS incorporating military computer hardware and ADA higher order language. Hardware and software fabrication of the developmental DMS is in progress. Radiological and chemical warning devices have been integrated with the DMS to provide protection against additional battlefield threats. Crew interface is being optimized through voice synthesis and visual display symbology.

A typical combat vehicle has as many as 100 incandescent lamps, which are illuminated during night operations. Through an ongoing secure lighting program, each lamp will be examined and redesigned to emit only energy visible to the human eye and to optimize its intensity using light-emitting diodes.

Various concepts for meeting vehicular lighting needs have been found and modification kits are being designed for combat vehicle blackout lighting systems. Modifications of all combat and tactical vehicles are scheduled to begin in the 1986-90 time frame. The effort is to be accomplished through Product Improvement Proposals (PIP).

SECURE LIGHTING PROGRAM

TACOM's investigation into detection at night by threat forces using low-light level (LLL) imaging devices revealed that current blackout security lighting is ineffective. The near-infrared portion of incandescent lamp emission "leaking" from openings in the hull and turret made the vehicle easily visible at ranges exceeding 2 km with LLL imaging devices. By restricting emission of a lamp to energy only in the visible portion of the EM spectrum, the signature of that lamp to a typical LLL device could be reduced by 28 dB with no loss of visibility inside the vehicle.

TACOM and TRADOC compared the signature of a blue-green infrared absorbing filter over a blackout dome lamp to that of a red filtered dome light. The red blackout light was clearly visible through LLL sensors while the blue-green light virtually disappeared.

ADVANCED COUNTERMEASURES

Vehicle "Signatures" are important vulnerability descriptors used as inputs to sensor directed anti-tank weaponery. Signatur measurements are routinely made in th infrared/thermal, visible and millimeter wav electromagnetic regions as well as in th acoustic spectrum. Reducing or modifying vehicle's signature is a primary objective o the Advanced Countermeasures program.

Reduction in quantitative signature level correspond to reduced detection and iden tification ranges for sensory directed anti tank weapons.

Signature Control is now an integral part o the overall vehicle survivability program No longer is it feasible to keep adding armo to a vehicle in response to new anti-tan weaponery. Survivability now depends on no being detected and when detected, not bein identified. Signature Control addresse these considerations.

NOTEWORTHY TECHNICAL CONTRIBUTIONS

Significant achievements have been made in reducing the thermal/infrared signature of combat vehicles through the use of thermal suppression hardware. Of specific interest are turbine powered vehicles which require special treatment of the hot exhaust gases to reduce their signatures.

Comparable achievements have been made in Acoustics, Millimeter Wave and Visual Signature Control. Future vehicles such as the Mobile Protected Gun and Close Combat Vehicle will incorporate signature reduction in their design as well as dedicated systems and material to reduce signature generation.

TECHNICAL ACHIEVEMENTS

MANAGEMENT OF RESOURCES

MM&T/MACI PROGRAM

Major studies were undertaken in FY82 in the growth and development of the TACOM MMT/MACI Program. Thrust areas included the M1 tank, the AGT-1500 Turbine Engine, the M2/M3 Fighting Vehicle Systems, MBT Track and Suspension, Advanced Special Armor Systems, Depot Modernization, and Tactical Vehicles. Targeted objectives include return on investment of 6.1; improved manufacturing productivity and quality; lighter vehicles; longer vehicle life; improved vehicle operating efficiency; updated manufacturing facilities; updated depot facilities; a strengthened mobilization base; and a strong manufacturing engineering team. The paths to these objectives include the application of new manufacturing technologies, the use of new materials, the adoption of commercial items, and the application of Industrial Productivity Improvement (IPI) Programs. TACOM budget figures for FY82 were slightly under $20 million while the FY83 budget will exceed $32 million. However, a shortfall is apparent in FY84. Individual program progress and implementation are reported elsewhere in this report.

IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

During FY82, the Tank-Automotive Concepts Laboratory conducted research in several scientific fields including optics, ultrasonics, radar, control theory, infrared, material properties, heat transfer and thermodynamics. Researchers in this program contributed a number of publications and presentations at scientific and engineering symposia. In addition, several researchers are combining their ILIR program with their Master and Doctoral dissertation requirements.

MOVING TARGET INDICATION (MTI) DEVELOPMENT

A real-time analysis of vehicle infrared imagery is becoming more important for vehicle battlefield survivability. The Moving Target Indicator (MTI) passively detects the presence of vehicle motion by using an image data reduction algorithm. The MTI supplies the tank commander with vital information such as the speed and direction of the target.

SCANNING PHOTOACOUSTIC MICROSCOPY

Scanning photoacoustic microscopy (SPAM) is a nondestructive evaluation technique applicable to the Adiabatic Diesel engine, to high performance gas turbine engines, and to track shoe pads. Since SPAM is dependent of thermal properties as well as optical absorption, it produces information that is different from optical images alone. The SPAM information may be produced as graphical displays, color video images and statistical measures. Color video can be used for a pseudocolor presentation of SPAM data and is necessary if both the phase and magnitude at a single point is to be presented simultaneously. Color video images have been produced combining the two in-phase and quadrature photoacoustic signals on a single pseudocolor graphic display.

INVERSE DESIGN MODELING OF FLUID FLOW PASSAGES WITH TEMPERATURE GRADIENTS

The inverse design technique provides TACOM with a rapid design/analysis capability for ducts, nozzles, and other flow passages within military gas turbine engines. This inverse design procedure has been applied to subsonic, sonic, and transonic compressible flow cases without singularities appearing in the final

solutions. A single streamline is specified by a frame independent streamtube formulation, and the spatial position of the calculated adjacient streamlines is plotted graphically as a computer output.

6.1 BASIC RESEARCH

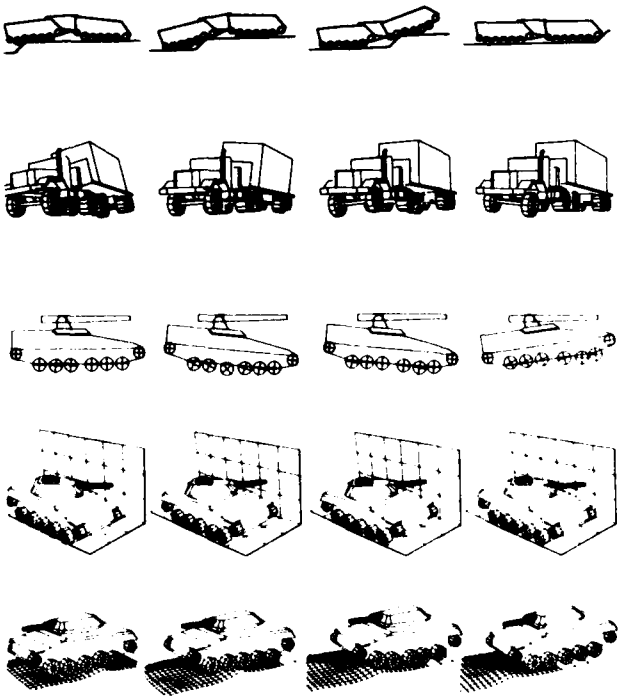
The Tank-Automotive Concepts Laboratory's work under "Research in Vehicle Mobility" is divided into four areas:

- Applied Mobility Research
- Countermeasures Research
- Dynamics and Control Research
- Materials and Components Technology

The Structural Image Analysis Program which began in FY81 continued into FY82. A stand-alone digital image processing system was acquired to analyze infrared and photometric images of U.S. and threat combat and tactical vehicles. A perceptability analysis was performed on several representative U.S. and threat vehicle images by digitizing them and determining subsequent noise threshold levels for trained Army observers. The final results were tabulated and compared with the theoretical guidelines for this type of signal-to-noise analysis.

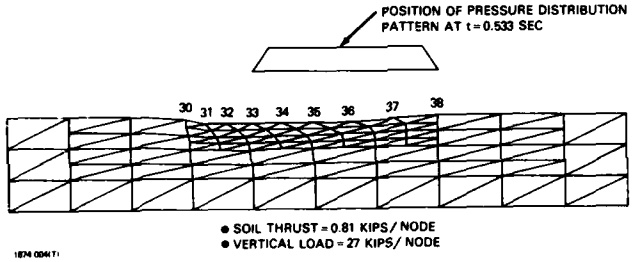
The Mechanics of Vehicle Systems research task has progressed in FY82. The Dynamic Analysis and Design System modeling method initiated by TACOM has been successfully applied to the analysis of numerous wheeled and tracked military vehicles. Spatial models of wheeled and tracked combat vehicles that predict cross-country ride and firing stability as a function of terrain, vehicle speed, and weapon recoil have been employed to enhance TACOM's evaluation process.

Elevation and azimuth controllers are being formulated to investigate weapon stabilization under various operating conditions. Articulated tracked and wheeled vehicle models (incorporating servo control systems) and soil-interface models are being developed to predict vehicle performance and to investigate controlled articulation enhancement of vehicle mobility. These vehicle models have significantly enhanced TACOM's current vehicle design and evaluation process and they form the basis for TACOM's full scale dynamic simulation research tasks.



SOIL VEHICLE INTERACTION RESEARCH

A methodology has been developed to determine the deformation of clay soils under moving track loads. It is now possible to quantify the effect of pressure distribution and travel velocity on soil deformation (specifically, slip, trim angle and motion resistance). First results indicate that these effects are significant. The method has potential of becoming the a design optimization tool.



MESH AT t = 0.533 SEC TIME. DEFORMED UNDER UNIFORM PRESSURE MOVING AT 30 ft/sec

6.2 EXPLORATORY DEVELOPMENT

Vetronics

The thrust of the vetronics program is to demonstrate more efficient integration of vehicle electrical/electronic systems and to demonstrate real time integration with the electronic battlefield. A series of three test beds is planned as follows: (1) An open frame electrical system test bed on which a generic electrical system (common to all combat vehicles) would be installed to demonstrate modularity and integration with subsystems; (2) A crew display demonstrator which would simulate normal vehicle control functions, the link to the electronic battlefield and training simulation; (3) A mock-up vehicle demonstrator for evaluation of training, maintainability and fix forward. The test bed demonstrators would act as a focal point for interchange with the user, ILS personnel, engineers, university personnel and contractor personnel.

The objectives in FY83 are to select a Systems Engineering contractor, to initiate the design of the crew display demonstrator and to begin acquiring hardware for the TACOM Vetronics Laboratory.

STANDARDIZED FIRE SUPRESSION COMPONENTS

Laboratory testing continued for components and systems submitted against purchase description (PD) ATPD-2070, Sensor, Fire, Optical, and ATPD-2071, Extinguisher, Fire (Halon-1301). The tests are for PD validation, encompassing 90 to 95% of the PD first article requirements. These laboratory tests have emphasized PD inadequacies, overly rigid requirements and simpler tests methods. In FY83, the final version of the PD will incorporate all changes resulting from the validation program. Military specifications will be written and published in FY84 based on the final version of the PD. The PDs are currently being used by the Project and Weapon Systems Managers of the M60, FAASV and M109. Several internal invention disclosures have been prepared as a result of this program. These include a Solenoid Operated Diaphragm Valve for Fixed Fire Extinguishers; a Tapered Spiral Expansion Motor; a Optical Sensors, Field-of-View Locator Device; a Rapid Acting Two Stage Pyrotechnic Valve for Fixed Fire Extinguishers; Nozzles for Halon Portable Fire Extinguishers and/or Distribution Piping; and Nozzles for Fixed Halon Fire Extinguishers and/or Distribution systems.

SIMPLIFIED TEST EQUIPMENT-TRACKED VEHICLE (STE-T)

STE-T expanded the Simplified Test Equipment for Internal Combustion Engines (STE/ICE) concept to totally support the M1 tank and M2/M3 Fighting Vehicle systems. STE-T features are a dynamic measurement/control of stabilization system, dynamic measurement of engine system, automatic cable test, organizational diagnostic with functional subsystem test strategy, standard STE/ICE test capability, comprehensive self-test/self-diagnosis capability and operation capability in combat vehicle environment.

During FY82, application programs for the M1 tank were validated 100% and were initiated for the M2 and M3. Completion for the latter is scheduled for December 1982. Fighting Vehicle contractor Engineering Development Testing was completed in February 1982 and Government Prototype Qualification Testing was completed in May 1982.

Seventy STE-T sets have been fielded in support of the M1 tank program and eighteen in support of the M2/M3 Fighting Vehicle Systems.

Type Classification of STE-T is anticipated for December 1982 and IOC is projected for March 1983.

Upon completion of this program, STE-T will become the standard test system for all combat vehicles until the second generation system, Simplified Test Equipment-Expandable (STE-X) becomes available.

6.3 ADVANCED DEVELOPMENT

SIMPLIFIED TEST EQUIPMENT-EXPANDIBLE

An Advanced Development contract was awarded in Mar 81 for Simplified Test Equipment-Expandable (STE-X), a test set with field reprogramming capability and expansion capabilities to test all combat systems. Full scale Engineering Development contract was awarded in Sep 82. System and hardware/software interface specifications, system level I drawing package, microprocessor software development, and a breadboard STE-X core were some of the items resulting from this contract.

ADVANCED PROGNOSTICS

Advanced Prognostics Program objectives are to improve vehicle availability and readiness by predictive maintenance; to reduce maintenance costs by reducing parts and labor requirements; to provide the unit commander knowledge of his vehicle's condition by predicting vehicle component failure and time or mileage to failure using modified Vehicle Monitoring System (VMS) hardware and software.

The technical effort involves development and expansion of prognostic technology (hardware, software, sensors, transducers, test methods and data analysis). Successful prognostic tests will be incorporated into vetronics. FY82 progress includes fabrication, demonstration and a successful Government acceptance test of three additional sets of prognostic equipment; computer demonstration of the M35A2 truck diesel engine startabilty algorithm; and the start of a prognostic data analysis in the TACOM prime computer.

The VMS Electronics Assembly (VMSEA) is vehicle mounted and has a memory which controls data manipulation, storage, decisions, calculations, and trend analysis. An integral battery preserves the memory and data if the vehicle battery is disconnected. The Set Communicator permits communication between the operator and the VMSEA or vice versa (automatic display of trend data or alarms). Maintenance Action Input device is used by maintenance personnel to enter maintenance activity and man-hours into the VMSEA memory. The Data Retreival Equipment (DRE) can transfer data from the VMSEA to a cassette tape, load a new program into the VMSEA, initiate VMSEA self-test and perform all required VMSEA initialization tasks necessary prior to start of testing.

NOTEWORTHY TECHNICAL MANAGEMENT ACTIONS

COMPARISON OF THE FY81 AND FY82 ILIR PROGRAMS

Fifteen individual ILIR tasks were funded in both FY81 and FY82; however, the total FY82 funding was $150,000 or 25% less than for FY81. As a result, TACOM has had to reduce the funding level for each task. In addition, 14 of the original 29 task proposals remained unfunded for FY82. Eight of the investigators, including four Master and four Doctorate level graduate students, are combining their dissertation requirements with their In-House Laboratory Independent Research (ILIR) programs. This provides a direct method for supporting university research programs while increasing Army technical in-house expertise. Programs affected are the FY82 speckle interferometric stress analysis, adiabatic diesel and gas turbine ceramic component materials research, passive target vehicle motion detection, and modern control theory algorithm development.

MAJOR PERSONNEL AND MANPOWER DATA

	Auth.	On Board	Doctors	Masters	Bachelors	Tech/ Other	Av. Age	Av. Grade
Military	32	26	1	15	6	4	37.1	Major
Civilian	505	504	13	54	201	101/ 135	45	10.7
TOTAL	537	530	14	69	207	240	-	-

MAN YEARS/FUNDS	DARCOM			NON-DARCOM		
	RDTE	PROC[1]	OMA	RDTE	PROC[1]	OMA
Classified Act	358/123M	-	165.3/5,289.2	26/.9M	-	-
Administration	-	-	-	-	-	-
Prof. (S&E)	-	-	-	-	-	-
Prof. (Other)	-	-	-	-	-	-
Technicians	-	-	-	-	-	-
Support	-	-	-	-	-	-
Wageboard	33/.9M	-	41.1/1,214.5	2/.1M	-	-

PROC[1] + REIMBURSABLE FUNDING

MAJOR MANAGEMENT IMPROVEMENTS

INTERNATIONAL TECHNOLOGY EXCHANGE

The principal mechanism for tank-automotive technology exchange and hardware standardization within the NATO community is the Combat and Support Vehicle Panel of the NATO Army Armament Group (NAAG) and the Automotive Components Standardization Study Group.

Tank-Automotive Rationalization, Standardization and Interoperability activities are also conducted under the Quadripartite Standardization Agreement, Bilateral Programs, International Memoranda of Understanding and Data Exchange Agreements (DEA).

TACOM is assigned major responsibilities for the conduct of two tank-automotive oriented bilateral programs: 1) The US/UK Armored Fighting Vehicle Working Party, and 2) the US/FRG Future Armored Vehicle Research Coordinated Testing program. The objective of these programs is to review national R&D programs to permit the coordination of R&D activities and mutual sharing of resulting information.

TACOM has 16 technical project officers (TPOs) and 27 assistant technical project officers (ATPOs) to maintain communication with foreign counterparts concerning TACOM activities. The Annual DEA Report is prepared by TACOM TPOs, and forwarded to DARCOM. The report, based on the year starting 1 Aug and ending the following July, presents the consolidated activity and status for each DEA during that period.

There were three visits by TOPs and ATPOs during FY82 to European countries to exchange information under the auspices of DEA, and a visit to England under the ABCA Agreement.

ITO was involved in 15 visits, totaling 32 visitors to TACOM and TACOM contractors. Foreign visitors included notables from Korea, Japan, Israel, Australia, United Kingdom, and other European countries. Briefings were held on laboratory facilities, advanced tank-automotive concepts, research and engineering, ITV, HSTV, M60, M1, STE/ICE, future tank-automotive concepts, survivability, suspensions, propulsion systems, and quality assurance programs.

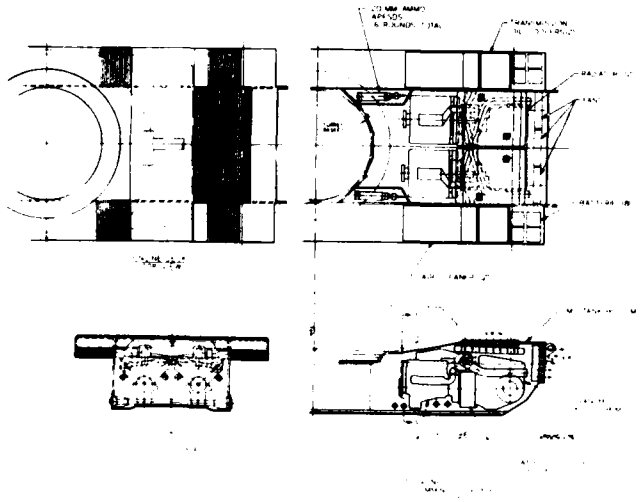
MATERIEL DETERIORATION PREVENTION AND CONTROL (MADPAC)

In May 82, TACOM established an action office to provide command-wide coordination of efforts in corrosion prevention. This office works through the existing TACOM function in both the R&D Center and Readiness Command to establish and implement a Materiel Deterioration Prevention and Control (MADPAC) program. This program covers all systems and equipment which rely on support from the Command through their life cycle. The action office acts as the principal point of contact at TACOM for all corrosion and materiel deterioration related matters and provides a MADPAC interface with DARCOM. The goals to be achieved are: increased system readiness, reduced maintenance cost, and longer vehicle life.

MAJOR MANAGEMENT IMPROVEMENTS

COMBAT VEHICLE SUBSYSTEM INTEGRATION

This program has been undertaken to integrate future vehicle subsystems. Dual VTA 903 engine and X1100 3B transmission were configured in an M1 engine compartment; small and large caliber cannons and new turrets were integrated in the M551; M68 cannons were configured with auto loader and integrated in new weapon stations; a Stinger missile system was integrated on an M2; and a Mack E-9 Hper Bar engine was also integrated in an M1 engine compartment.



ENGINEER AND SCIENTIST (E&S) CAREER INTERN PROGRAM

Increased management attention was brought to this program during FY83 by the formation of a Technical Advisory Board. That board was tasked by the R&D Center Commander to:

a. Oversee the work/training assignments of all E&S Career Interns, monitor their progress, and assure their effective utilization during and after completion of the internship.

b. Develop interview criteria for new interns, interview prospective interns, and make selection.

c. Counsel/advise interns regarding education, training, and career development and advancement.

d. Assess the quality and effectiveness of the E&S Career Intern Training Program.

Notable achievements during the year include the establishment of cooperative education agreements with two more universities (General Motors Engineering and Management Institute (GMI) and Lawrence Institute of Technology). In the case of GMI, which is co-op oriented, this has involved a major commitment of program emphasis. The payoffs are expected to be a better mix of male-female and minority - nonminority employees together with an improved employee retention profile.

The program has prospered and encompasses over 40 people against an authorized TD of 36 (co-ops count two for one). The TD ceiling was raised by DARCOM from 33 to 36 based on the strength of TACOM's program. Affirmative Action statistics in this area portend well for the future with female representation having increased from 8 to 12 percent and minority profile increasing from 4 to 8

percent. Emphasis will be continued in the coming year.

The next problem addressed will be the age distribution profile and a coming retirement surge. A review of the age distribution shows that about a quarter of the professional staff will retire in the next ten years. Given the eight-year time lag to train a productive engineer, considerable emphasis will be given to the next generation of professionals in the next two years. A related problem will be addressed simultaneously: The current average age of 46 versus a desirable average age of 36 for an R&D establishment. The program will next address development of a hiring strategy to attain and maintain that profile.

AGE DISTRIBUTION OF PROFESSIONAL
SCIENTIFIC AND ENGINEERING PERSONNEL BY GRADE*

AGE GROUP	SES	15	14	13	12	11	9	7	4/5	TOTAL
20-24						1	2 (4)	(2)	(9)	3 (15)
25-29			1	4	18	13	5 (5)	1 (6)	1 (1)	43 (12)
30-34			9	33	30	5	(1)	1	(1)	78 (2)
35-39		4	18	35	31	3	1			92
40-44		1	18	33	27	2	1 (2)			82
45-49		8	22	27	18	2				77
50-54	1	11	20	30	30	1				93
55-59	1	11	18	47	37					114
60-64		2	5	26	26	1	1			61
65-69			1	6	4	2				13
70-74				3	1					4
TOTAL	2	37	112	244	222	30	10 (12)	2 (8)	1 (11)	660 (29)
% of GRADE	.3	5.6	17.0	37.0	33.6	4.5	1.5	.3	.2	100.0
AVERAGE AGE	55.5	51.0	46.1	47.4	46.1	35.6	31.8	28.5	25.0	44.5

* () INCLUDES DARCOM INTERNS/CO-OPS

PLANNING FISCAL PROGRAM

TANK AND AUTOMOTIVE TECHNOLOGY FUNDING

The following chart constitutes the funding breakouts for TACOM's R&D Center Single Program Element Funding for the various efforts constituting AH91 as subject to change based on higher level guidance and the Commander's flexibility to redirect funds into areas which present higher potential payoff.

TANK AND AUTOMOTIVE TECHNOLOGY FUNDING

MOBILITY ADVANCED PROPULSION	FY82	FY83	FY84
Adv Adiabatic Tech	550	1000	1000
Eng Concepts - Alt Fuel	600	750	300
Adv Pwr Train Comp	600	600	600
Adv Air Filtration	600	600	300
Adv Turbine	400	700	1000
Alt Propulsion Systems	0	575	575
Advanced Concept Team	549	0	0
ADVANCED TRACK & SUSPENSION			
Track Technology	1,785	1,030	1,945
Suspension Technology	300	260	450
Track Hardening	0	200	450
Integ. Track & Suspension	65	110	0
ADVANCED ARMOR COMPONENTS			
Adv Comp Matl & Struct	0	500	500
Hi Strength Matl & Comp	200	300	600
SYSTEM CONCEPTS TECHNOLOGY EXPLOITATION			
Comb Veh Sys Integ	358	400	450
Comb Veh Support	300	350	350
TACL Concept Support	105	200	250
TASL System Support	360	500	500
NATO Cooperative Act	120	120	120
Veh Effectiveness Tech	650	780	650
Vetronics			545
Cbt Veh Analysis	370	500	600

PLANNING FISCAL PROGRAM

TANK AND AUTOMOTIVE TECHNOLOGY FUNDING (Continued)

	FY82	FY83	FY84
Full Scale Simulation	386	900	1962
CONFIGURATION CONCEPTS			
Future Veh Systems	800	1600	2000
SURVIVABILITY			
REDUCTION OF DETECTION			
Secure Lighting	107	300	300
Veh Image Control	0	350	250
AVOIDANCE			
Passive Countermeasures	1026	1000	1100
Hit Avoidance	0	600	700
REDUCED VULNERABILITY			
Cbt Veh Robotics	15	450	600
Fire Survivability Tech	900	800	750
Compartmenting (Ammo)	87	225	225
NBC Protection/Veh Integ	400	500	500
Armor Technology Integ	600	700	1000
Armor Integration	3999	0	0
Direct Energy Beam Reduction	230	200	300
Vehicle Hardening	0	405	425
SUPPORT			
Logistic Support Tech	0	300	400
Life Support Integ	0	250	500
ATEPS Technology	250	550	0
Adv Diagnostics/Prognostics	600	700	900
Noise Control	60	120	200
TOTAL	17,502	19,925	25,052

FY81 INSIDE/OUTSIDE PROGRAM
(In thousands)

EFFORT RDT&E FUNDS	INDUSTRY AND ACADEMIA CONTRACT/TOTAL EXPEND		OTHER DARCOM LABS CONTRACT/TOTAL EXPEND		OTHER GOV'T AGENCIES CONTRACT TOTAL EXPEND		ESTIMATED COST TO ADMINISTER	
	$K/$K	%	$K/$K	%	$K/$K	%	$K	%
	606		3		0			
6.1	1410	43%	1410	0%	1410	0%	22	2%
	7341		5305		117			
6.2	18302	40%	18302	29%	18302	0%	542	3%
	16734		6450		101			
6.3	29618	56%	29618	22%	29618	0%	1081	4%
	1454		5679		135			
6.4	8793	17%	8793	65%	8793	2%	86	1%
	12		—		80			
6.5	8482	0%	8482	0%	8482	1%	44	1%
6.7	—		--		--		--	
	26147		17437		433			
RDT&E TOTAL	66605	39%	66605	26%	66605	1%	1775	2%
PROCUREMENT FUNDS								
	407509		2538		17			
DARCOM	419522	97%	419522	1%	419522	0%	4195	1%
NON-DARCOM (OTHER ARMY)	---		---		---		---	
	6612		335		-			
NON-ARMY	9941	70%	9410	4%	9410	0%	97	1%
	414121		2873		17			
PAA TOTAL	428932	97%	428932	5%	428932	0%	4292	1%
OMA FUNDS								
	20		11		--			
DARCOM	7787	0%	7787	0%	7787	0%	0	0%
NON-DARCOM	-		--		--			
(OTHER ARMY)	19	0%	19	0%	19	0%	0	0%
	--		--		--			
NON-ARMY	941	0%	941	0%	941	0%	0	0%
	20		11		--			
OMA TOTAL	8747	0%	8747	0%	8747	0%	0	0%
	440288		20321		450			
GRAND TOTAL	504284	87%	504284	4%	504284	0%	6067	1%

OUTSTANDING ACCOMPLISHMENTS BY IN-HOUSE PERSONNEL

CAST ALUMINUM TURRET M2 AND M3 FIGHTING VEHICLE SYSTEMS

FMC Corporation will continue establishing production procedures to manufacture a one-piece cast-aluminum alloy A206 turret which will replace the currently fabricated M2/M3 turret. A cast turret requires less welding and machining than a fabricated turret. The estimated savings have increased from $1,000 to $2,000 per turret. The Phase I program was expanded during 1982, to obtain supplemental information on ballistic integrity of a cast turret. Progress toward the manufacturing of a one-piece aluminum turret will continue in Phase II, which is scheduled for completion in Oct 83.

MANUFACTURING TECHNOLOGY FOR TURBINE ENGINE COMPONENTS

Research to establish manufacturing technology for the fabrication of AGT-1500 engine components from advanced materials has been started. This project addresses advanced materials which exhibit superior high-temperature mechanical properties and can be used to increase the temperature tolerance and improve the durability of the parts. Rapid solidification rate disks have been fabricated using the consolidation by atmospheric pressure (CAP) process, followed by cross-rolling for secondary consolidation. These disks are currently undergoing mechanical property evaluation.

IMPROVED INSPECTION OF TRACK PIN SHOT PEENING

This project investigates the practicality of using automated X-ray diffraction (XRD) equipment for quality control of the shot peening operation in the manufacture of T142 track pins used on M60 tanks. Shot peened track pins and a track pin manipulator have been procured for in-house (TACOM) determination of measurement parameters and procedures. Automated XRD equipment configured for go/no-go operation has been procured. Measurement parameters and procedures have been determined. A procurement request for contractor implementation and validation has been submitted. Contract award is scheduled for early FY83.

BATTERY DEVELOPMENT

A performance specification for a new low-maintenance storage battery (6TL) for combat vehicles has been released for procurement. Also, a contract was awarded for the fabrication of a low-maintenance battery for tactical vehicles (2HL) for tests and evaluation. This battery will have the state-of-the-art features of the 6TL battery. Prototypes have been made in preparation for laboratory and field evaluation. Both the combat and tactical vehicle batteries feature high impact plastic containers. Both incorporate the maintenance-free concept for long-term "wet" storage life and reduced service and maintenance. Prototype delivery of 2HL batteries is scheduled for 1st Qtr 83. Evaluation tests will follow.

10-TON M.A.N.

Acquisition of the 10-Ton M.A.N truck was set apart from the Heavy Expanded Mobility Tactical Truck (HEMTT) program to fulfill the requirements of the Air Force Ground Launched Cruise Missile (GLCM) and the Army Pershing II (PII) Missile systems, which are being deployed in Europe. By utilizing the M.A.N. Truck, the existing M.A.N. supply and maintenance service center network will be used. The M.A.N. truck has four basic configurations: An M1001 PII tractor with a 20 tonne-meter crane; an M1013 GLCM tractor with a 6 tonne-meter crane; an M1014 GLCM tractor without crane; and an M1002 wrecker/recovery vehicle with a 20 tonne-meter crane in support of both the PII and GLCM systems. A contract for 15 vehicles was awarded on 31 Oct 80. Seven of these vehicles were delivered from Jul through Sep 81 for Initial Production Testing. In a Dec 81 Program Review, approval was granted for the FY82 procurement of 104 vehicles. The first two of these vehicles were delivered on schedule in Sep 82 to support the GLCM. The contract contains provisions for purchasing up to a total of 468 vehicles.

IMPROVED AND COST EFFECTIVE MACHINING TECHNOLOGY FOR TRACKED COMBAT VEHICLES

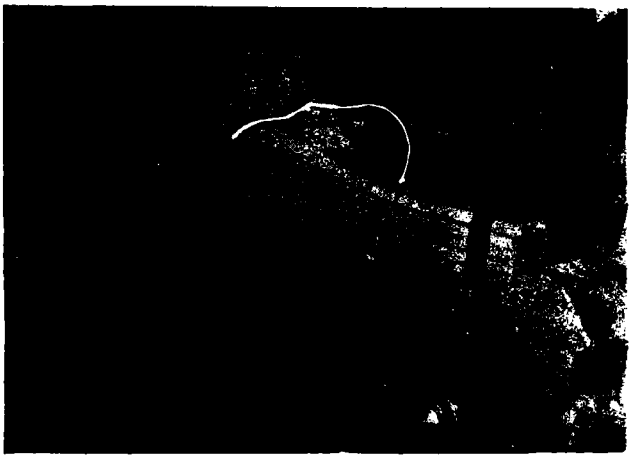
The purpose of this program is to improve machining technology in metal removal for manufacturing tracked combat vehicles components. Efforts completed under Phase I and Phase II include the development of improved and cost effective technology for turning, face milling, end milling, drilling and tapping. In Phase III, a machinability handbook will be developed summarizing cost effective machining data into user-oriented data tables. It will give recommended cutting tool geometry, cutting fluid, and such machining conditions as speed, feed, and depth of cut for each combination of work material and machining operation tested.

DRIVER TRAINING VEHICLE FOR GROUND LAUNCHED CRUISE MISSILE SYSTEM

The Driver Training Vehicle (DTV) Program was initiated to provide training for truck tractor operators and deployment personnel without using the actual multi-million dollar Ground Launched Cruise Missile (GLCM) system. The DTVs, mounted on production XM986/999 Transporters, simulate the GLCM payload, center of gravity and vehicle handling characteristics, deployment functions and camouflage interface. TACOM began development of the DTVs in early FY82 and fabrication of six prototype systems began Mar 82. Delivery of the prototypes to an Air Force training squadron is scheduled for Jan 83. A production contract for 38 DTVs will be awarded in early FY83 with initial deliveries scheduled for Jun 83.

FIBERGLASS EPOXY COMPOSITE LEAF SPRINGS

Fiber reinforced plastics applied to structural components can reduce vehicle weight and improve fatigue life and corrosion resistance. Manufacturing and materials costs preclude the use of these plastics in tank/automotive applications and make their superior properties unavailable to designers of tactical and combat vehicles.



TACOM is developing manufacturing methods and technology to reduce the cost and improve the productivity of fiberglass epoxy leaf springs. A set of springs has been designed for the 5-ton truck. Hybrid spring sets (front and rear) which utilize S-glass/epoxy, along with steel leaves, have been fabricated utilizing an automated tape lay-up process. These components are expected to have mechanical properties superior to the current all steel version and also to exhibit a 50% weight savings. The fabricated units will be tested at TACOM during FY83.

PROGRAM BALANCE SHEET

FY82 FUNDING

FROM ALL SOURCES INCLUDING CUSTOMERS

(IN THOUSANDS)

			FY82	
RDT&E FUNDS			**SUBTOTAL**	**TOTAL**
6.1	Research		$ 1,410	
6.2	Exploratory Development		18,302	
6.3	Advanced Development 6.3A	$23,414		
	6.3B	6,204	29,618	
6.4	Engineering Development		8,793	
6.5	Management and Support		8,482	
	RDT&E TOTAL			$66,605
PAA FUNDS				
HQ				
DARCOM		417,164		
OTHER		2,358	419,522	
NON-DARCOM (OTHER ARMY)				
NON-ARMY			9,410	
	PAA TOTAL			$428,932
OMA FUNDS				
HQ				
DARCOM		2,001		
OTHER		5,786	7,787	
NON-DARCOM (OTHER ARMY)			19	
NON-ARMY			941	
	OMA TOTAL			$ 8,747
	GRAND TOTAL			$504,284

The chart shows the funding posture for FY82. A total of $504.3 million was authorized. Of this amount, $66.6 million or 13% was RDT&E funded; $428.9 million or 85% was funded by the Army Procurement appropriation; and $8.7 million or 2% was provided by OMA.

TANK-AUTOMOTIVE CONCEPTS LABORATORY

TANK TEST BED

Based on in-house research on future tank designs, a new tank system configuration has been identified which, by placing the main weapon external to the crew compartment, offers dramatic improvements in tank weight, survivability, and NBC protection.

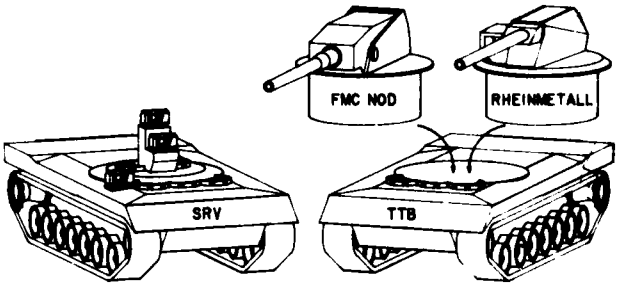
These improvements require resolution of specific operational and technical issues associated with vision and automatic loading. The program approach of demonstrating technical solutions to these issues involves the Surrogate Research Vehicle (SRV) and the Tank Test Bed (TTB).

On 23 Jun 82, a single contract was awarded to General Dynamics, Land Systems Division for design, fabrication, and test support of the TTB. During FY82, General Dynamics, Land Systems Division began detailed design and fabrication of two brassboard automatic loader concepts: one by FMC Corporation, the other by Rhienmetall of West Germany. Results of the brassboard automatic loader testing, a full-scale wood mock of the TTB, and the supporting vehicle analysis necessary for the contractor to assess progress on the critical design issues will be completed at the end of the first year of the design and fabrication effort.

To provide an early operational assessment of the TTB vehicle concept, the U.S. Army Armor Center will perform a series of SRV operational evaluations for TACOM. SRV testing will start in February 1983 to evaluate the TTB crew configuration prior to the one-year TTB review. The purpose of the test is to identify potential problems associated with the crew location, crew size, and sight location. Subsequent testing will explore technologies related to improving surveillance and vehicle command and control capabilities.

The detailed SRV design began in April 1982 with the chassis being modified in-house and the turret and electronics being developed under contract with Litton and their major subcontractor, the Pietzsch Company of West Germany. Design of the turret and chassis have been completed. Fabrication and assembly are scheduled for completion in December 1982.

TANK TEST BED PROGRAM



OPERATIONAL ISSUES
- -CREW CONFIGURATION
- -SURVEILLANCE
- -VEHICLE COMMAND & CONTROL

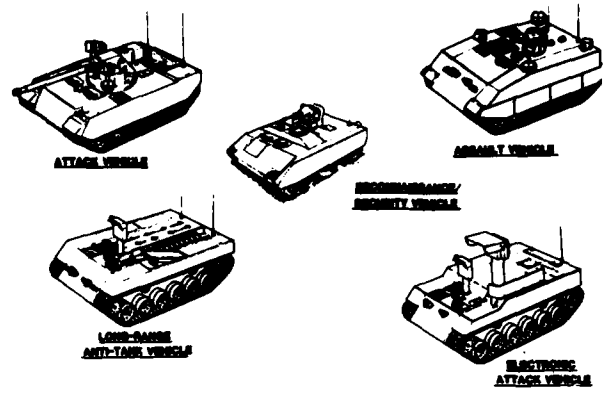
TECHNICAL ISSUES
- -AUTOMATIC LOADER
- -REMOTE WEAPON OPERATION
- -INTEGRATION REQUIREMENTS

FUTURE CLOSE COMBAT VEHICLE SYSTEMS

The Tank-Automotive Concepts Laboratory has completed the first phase of a program to generate a family of close combat vehicles designed to meet and defeat the long range armor threat. This first phase, the Future Close Combat Vehicle System (FCCVS) effort, concentrated on the 1990-2000 time frame with the concepts required to utilize technologies possible for a 1995 fielding. The participants of this effort received a briefing from TRADOC on the Air Land 2000 operational concept and a number of briefings from other DARCOM Commands on the projected threat, development progress in armament and armor and projections of other technologies applicable to close combat vehicles. These briefings resulted in the identification of the system capabilities required for a family of future close combat vehicles, which in turn dictated the characteristics and capabilities of the individual vehicles. The deliverables were families of vehicle concepts, along with the rationale supporting the composition/capabilities of the families. These were to be evaluated by a combined team of TACOM, other DARCOM and HQ DA participants.

These evaluations will highlight the vehicle concepts and technologies resulting in significant improvements in combat effectiveness by the FCCVS family. The evaluations will also examine the effect of supplementing the current close combat vehicle family (M1/M2/M3) with individual vehicle concepts or specific technological advances.

FUTURE CLOSE COMBAT VEHICLE SYSTEMS (FCCVS) CONCEPTS

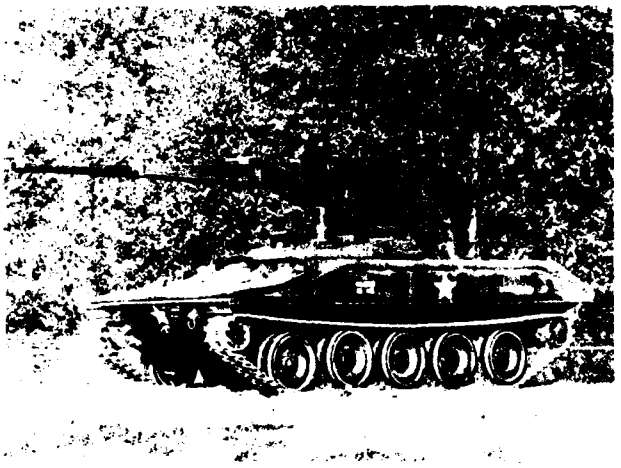


ELEVATED KINETIC ENERGY TEST BED PROGRAM

The Elevated Kinetic Energy (ELKE) Test Bed Program's objective is to design and fabricate a technology demonstrator to evaluate a combat vehicle which mounts an automatic cannon or has elevating trunnions to allow it to fire from defilade.

The assembly and integration of components and major subsystems began in fourth quarter of FY81 and was completed in third quarter of FY82. Contractor testing was completed in fourth quarter of FY82.

During FY82, the autoloader/feed system was successfully tested and a 400-round safety certification cycle was completed. Preliminary test firing for safety certification will be conducted in the first quarter of FY83 at Yuma Proving Ground (YPG). Following safety certification testing, a government evaluation will be conducted at YPG during the first half of FY83.



The ELKE Test Bed will allow the development and evaluation of new tactics utilizing defilade positioning and provide a technology base for the assessment of weapon dynamics, auto-loaders, and fire control requirements of future weapons systems.

WILLIAMS AERIAL SYSTEM PLATFORM (WASP II)

In June 1982, the Williams Aerial Systems Platform (WASP II), built under contract by TACOM, successfully completed Concept Evaluation Program (CEP) testing by the US Army Infantry Board (USAIB) at Ft. Benning, GA. The test objectives were to determine if selected test soldiers with no previous flight training could be trained to operate an Individual Lift Device (ILD), and to provide data on functional performance, limited maintainability, logistics, human factors and safety concerning operation of the WASP.

Since the ILD is not intended to be operated by rated aviators, a Preliminary Airworthiness Evaluation (PAE) was required before any test soldier could be trained. Results of this evaluation led to an airworthiness release by AVRADCOM which TRADOC required before a safety release could be issued. The safety release permitted the test soldiers to perform free-flight operations during training and CEP testing.

The data obtained from the CEP testing will be used by the US Army Infantry School (USAIS) to formulate a decision concerning further development of the ILD. The USAIB found that selected test soldiers with no previous flight training can be trained to operate the ILD, and trained operators can identify specified control points and objectives while operating the ILD over a pre-planned route.

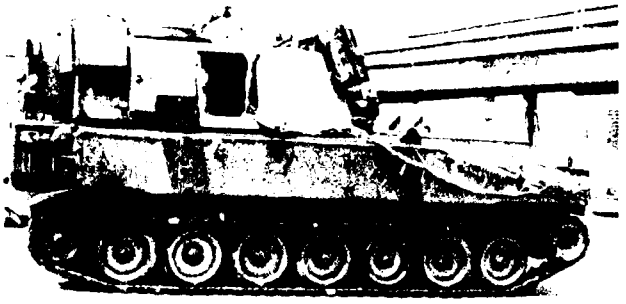
In 1983 TACOM plans to test the WASP II as part of the High Technology Test Bed Rapid Deployment Force evaluations taking place in Yakima, Washington. These evaluations will determine the operational capabilities of the system when utilized as part of the Army's Light Division force structure.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

DIVISION SUPPORT WEAPON SYSTEM (DSWS)

TACOM support in FY82 for development of the DSWS with ARRADCOM has continued to include a power pack installation study, baseline vehicle cost estimates, and vehicle mobility analysis. The power pack installation study examined various engine-transmission combinations, each possessing approximately 500 horsepower, to determine which combination would best fit the M109 vehicle and what modifications, if any, would be necessary for a satisfactory power pack -hull interface. Automotive chassis cost estimates were developed and validated for the M109 MAXI-PIP and the new concept DSWS Self-Propelled Howitzer (SPH) and ammunition resupply vehicle (ARV). These estimates were forwarded to ARRADCOM for inclusion into the DSWS independent cost estimate. The mobility analysis evaluated the performance of several candidate vehicles for their potential in meeting DSWS requirements established by the US Army. Candidates included the current Self-Propelled Howitzers along with their supporting vehicles; the M109 MAXI-PIP and the Field Artillery ammunition Resupply Vehicle in a support role; and a complete new family of vehicles designed to meet the DSWS requirements. Using several mobility performance models, vehicle characteristics such as acceleration, sustained speeds, ride quality and cross-country performance were predicted.

Ongoing studies include a dynamic load and stress analysis, a weighted M109 road test and NATO 400-hour engine test. The weighted M109 road test, in conjunction with a finite element stress analysis, will help determine whether the present chassis and suspension can support the weight of the MAXI-PIP. The NATO 400-hour Engine Test of the Detroit Diesel 8V71TA engine has been set up and instrumented here at TACOM. The purpose of the 400-hour engine test is to analyze the operation of the Detroit Diesel 8V71TA using high sulphur fuel. All studies and tests will be completed first quarter of FY83 and be briefed at the ASARCI/DSARCI review in the second quarter of FY83.

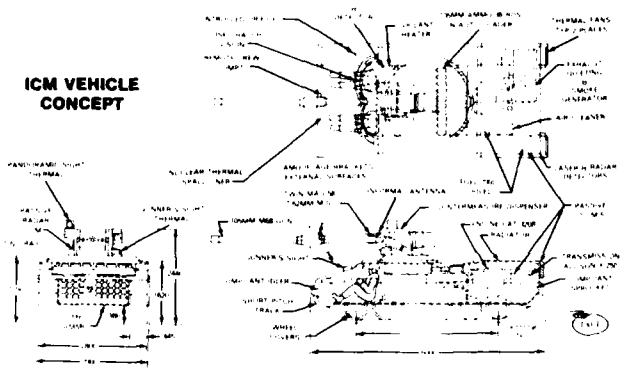


INTEGRATED COUNTERMEASURE (ICM) VEHICLE TEST BED

The ICM Vehicle Test Bed Program progressed through concept development into initial evaluation.

A number of countermeasure (CM) devices and signature suppression techniques have been investigated on existing vehicles. However, a cohesive system of combining these devices and techniques in a test bed has not previously been undertaken.

Five vehicle configurations were developed featuring internal and external remote weapon stations, auto loading cannons, a variable height suspension system, and rear turbine and compression ignition power plants. Infrared, acoustic and photometric evaluations were inititated on these concepts.



These evaluations will be used to design and develop the ICM test bed. It will be evaluated to determine technical feasibility, combat effectiveness, and user acceptance.

COMBAT VEHICLE AMMUNITION COMPARTMENT INTEGRATION

The ultimate goal of this task is to develop design guidelines for compartmented ammunition which will provide survivability for both the crew and the vehicle following a hostile penetration of the ammunition compartment.

The FY82 research effort consisted of the assessment of full scale ammunition compartments, an investigation of the effectiveness of sleeved water jackets (to reduce the fratricide effects of ammunition penetrated by large caliber warheads) and a feasibility study of propellant cook-off control systems.

During the first quarter of FY82, the effects of both Light Antitank Weapon (LAW) and GAU-8 30 mm threats on compartmented 105 mm ammunition stored in sleeve water jackets were assessed at Jefferson Proving Ground, Indiana. Preliminary results indicate that water jackets are effective in preventing fratricide in full scale ammunition compartments.

An investigation into the effects of the Dragon shaped-charge warhead threat against 105 mm and 120 mm ammunition was also conducted. Initial results indicate that water jackets again proved useful in reducing propellant fratricide and that the detonation of compartmented ammunition by the Dragon warhead produces higher vent pressures than the LAW warhead.

Future investigations will include the resolution of autoloader integration restrictions; the determination of cook-off control system requirements and limitations; the stowage of high-energy propellants; and the effects of a hostile attack on compartmented 75 mm ammunition.

VEHICLE EFFECTIVENESS TECHNOLOGY FY82 ACCOMPLISHMENTS

The first developments under the Vehicle Effectiveness Technology (VET) system began to show a return to TACOM in fiscal 1982. The "mini" VET became operational, and streamlined the ongoing vulnerability and survivability analysis of combat vehicles by the Tank-Automotive Concepts Laboratory. Programs for interactive data input and data consistency checking in several mobility analysis models have also been completed, and are increasing the productivity of TACOM engineers. At present these programs are being used as stand-alone tools, although they will eventually be incorporated into the VET system. When the technical documentation is completed early in fiscal 1983, these programs will be available to outside users of the mobility models.

Other developments in the VET task are the computer/computer and computer/man interfaces that will be necessary for the analysis capability in the full VET system. A prototype computer/computer interface between the CAD system in the Concepts Laboratory and the Prime computers in the Systems Laboratory enables the data for a vulnerability model to be extracted from the CAD data base and sent directly to the Prime computer where the model will run. Future effort will broaden the capabilty to include data for other models.

COMBAT VEHICLE ANALYSIS AND EVALUTION

Dynamic evaluations including mobility, firing stability, hit probability, survivability and design trade offs were undertaken on a number of combat vehicle concepts and near term prototypes. Some of the major assessments are listed below.

Mobility analyses and evaluations were conducted using the NATO Reference Mobility Model (NRMM) on the following vehicle systems: candidate systems for the Division Support Weapon System (including existing self-propelled howitzers along with new vehicle concepts for self-propelled howitzers); a mobility performance comparison for the standard M151A2 ¼-ton truck versus a generic light attack vehicle being evaluated by the 9th Infantry; several candidate vehicles for the Light Air Defense System (LADS); and several candidate vehicles for the Army Maintenance Vehicle/Medical Evacuation Vehicle (AMV/MEV).

Weapon station firing stability analyses were performed for a variety of large caliber main weapon systems. Vehicle dynamics simulation models were exercised to determine the firing stability of new combat vehicles employing a variety of large caliber weapons, including the 120 mm cannon and the 145 mm TCAS cannon. It was determined that it is possible to fire up to a 145 mm cannon from a 60-ton class vehicle. Preliminary results have also shown that standard M68 cannon systems must be modified through longer recoil or muzzle breaks in order to be fired from a 20-ton class vehicle.

A target area hit probability evaluation methodology was established to predict hit probabilities for stationary targets. Initial results using this simulation model indicated that a 15 percent to 20 percent decrease in hit probability may be expected if an external remote weapon station is integrated into heavy tank design instead of the traditional full turret.

Initial assessments were conducted on the Future Close Combat Vehicle System, pointing out that additional vehicle functions such as high energy lasers and long range anti-tank subsystems may be required to support the future air/land battle 2000.

COMPUTER MODELING OF VEHICLE SIGNATURES AND SIGNATURE SUPPRESSION HARDWARE PERFORMANCE

Computer modeling techniques are now available to model the signature of postulated vehicles in the infrared/thermal spectral regions. The model can predict the surface temperatures of various regions of a concept vehicle's exterior and display them in graphic form for numerous azimuthal and elevation look angles. Using this model as an aid, the effectiveness of Signature Suppression hardware can be evaluated in terms of reduced vehicle vulnerabilty to detection by sensory systems. A portion of the model is made up of a weapon system performance subroutine which accepts modeled signature data and critiques the vehicle in terms of its vulnerability to a number of thermally based weapon systems.

TECHNICAL ACHIEVEMENT BY PROGRAM BREAKOUT

TANK-AUTOMOTIVE SYSTEMS LABORATORY

OVERHEAD ARMOR PROTECTION

Data received from Aberdeen Proving Ground on tests conducted in FY82 indicate a variety of composite plate structures that can be used either structurally, or as appliques, to roof armors to prevent crew compartment penetration of either jets from M-42 HEAT or fragments from STAFF type SFF munitions. Computer generated data from the Ballistics Research Lab further indicates that such structures offer protection factors of the order of 6 to 8 from nuclear radiation. This is due to a two-inch polyethylene layer on the inside of the roof and turret of a tank. Further work along this line including ceramics, aluminum, glass, polymerics, borated and litherated doped resin is being funded at the Army Materials & Mechanics Research Center and BRL for a combined amount of $850,000 in FY83.

ARMOR DEVELOPMENT AND DEMONSTRATION

This armor project is aimed at rapid assessment and assimilation of armor technology and the integration of both traditional and non-traditional survivability measures in combat vehicles. The program includes overhead and applique armor systems, the prototyping of advanced armor designs, and computer modeling to determine vehicle vulnerability and survivability.

Additionally, a program was initiated with the Jet Propulsion Laboratory to take advantage of lightweight materials technology in the design and fabrication of a lightweight armor structure.

HIGH PERFORMANCE CONE BRAKE

The high performance cone brake (HPCB) project objective was to modify commercially available cone brakes to fit an M939 5-ton truck. Comparison tests of the standard air brake system against the HPCB were conducted and evaluated for brake performance, heat rejection and for the ability to expel contaminants. Two sets of brake lining were used on the standard brakes during the six 8,000 stop cycle test. Normal wear was observed. The HPCB also used two sets of brake lining; in addition, it required the rebuild of the cone brake actuator unit and installation of new pistons. The latter test was concluded after 572 stop cycles due to excessive heat build-up and loss of inner brake lining. This project was terminated during the Phase I effort because the excessive heat retaining characteristics of the HPCB assembly cannot be controlled. The HPCB brake assembly must be redesigned.

MILITARY ELASTOMERS

The finite element analysis codes and math models for the fundamentals of elastomers (track pads) have been input into the TACOM scientific computer system. Programs have been undertaken in fracture analysis of viscoelastic materials, damage accumulations, crack initiations, and crack propagations.

The aim is to assure adequate dispersion capacity in materials and to establish standards for acceptable dispersion of energy, stress, and temperature over a large area.

TECHNICAL ACHIEVEMENT BY PROGRAM BREAKOUT

M939 SERIES 5-TON TRUCK

The M939-Series 5-Ton Truck achieves increased mobility, durability, and serviceability, while retaining maximum possible parts interchangeablity with the M809-Series 5-ton truck.

A contract for production was awarded to AM General Corp. on 8 April 1981 and delivery of Initial Production Test (IPT) vehicles began in January 1982. Six IPT vehicles underwent 120,771 miles of durability tests and two performance tests. The five year contract entails production of 11,394 vehicles in support of Army, Air Force, and Marine requirements with a 100% increase option provision. The award of a System Technical Support Contract on 24 April 1981 made available the increased manpower necessary to apply current industry expertise and production technology to the Technical Data Package. The initial operation capability date for this system is February 1983.

DESIGN FOR BALLISTIC SHOCKS

Under contract, Southwest Research Inc., has conducted ballistic shock tests. An analytical shock methodology has been established and validated to provide a design for mounting systems of internal components in combat vehicles. The approach can be used to enhance protection against external ballistic shock.

NEW MATERIALS AND PROCESSING

TACOM has created a program for ballistic screening of new or novel armor materials or systems. The program is being used for unsolicited proposals that produce new or novel materials for ballistic evaluation.

A standardization program has been established for review of materials or processes and for subsequent ballistic screening tests at Aberdeen Proving Ground.

SUPPLEMENTAL ARMOR ENGINEERING SUPPORT

Technical support was provided to the M9 Armored Combat Engineer vehicle Project Manager in the development, direction, and analysis of ballistic test programs. These programs include evaluation of ballistic protection capabilities for the M9 engine grille, and a recommended course of action for the applique steel/aluminum armor program.

VEHICLE HARDENING

This program has been transferred from MERADCOM to TACOM. The present concept uses a single nonmetallic road wheel which runs in a groove in a polyurethane encapsulated steel track. This wheel can withstand a 12.5 lb. land mine. This program was unfunded in FY81 and FY82, but has been reinstated for FY83.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

ADVANCED SUSPENSION SYSTEMS

The Advance Suspension Systems program is set up to meet the increasing demands put on the suspension system of recently fielded and future tracked military vehicles. In FY83, actuator seals for hydropneumatic suspension systems will be developed to increase the RAM-D of the hydropneumatic suspension systems. Also, a pneumatic-spring, hydraulic-damping, in-arm suspension system will be evaluated for possible vehicle application in the 20-25-ton weight class of vehicles.

LOOPWHEEL SUSPENSION

The Loopwheel Suspension Program was established to evaluate the feasibility of the loopwheel concept for military automotive vehicles. This concept eliminates such components as roadwheel arms, roadwheels and torsion bars, and has the potential for providing a lighter, simpler suspension system. During FY82, core life was increased from 400 - 1,200 miles to 3,000 - 14,000 miles (accumulated on the moving belt dynamometer). A loop durability of 3,000 miles on the loop wheel development vehicle dynamometers was achieved. A significant increase in core life led to the discovery of more hardware problems, such as several strap breakages. There is no plan to continue this program in FY83 due to insufficient progress in development of this high risk item.

TRACK RETENTION AND CONTROL

Drive sprocket with resilient teeth - the teeth are mounted on the sprocket body and are partially encased in rubber to permit slight yielding as driving loads are applied. The objectives are: improved track engagement; reduced loading, noise, and vibration; and improved track and sprocket life. A set of sprockets has been fabricated and testing has been initiated on an M113 armored personel carrier.

Track tension adjustment system - this system will permit the driver to monitor and adjust track tension while the vehicle is underway. The objective is to maintain optimum track tension to eliminate track loss and assure satisfactory vehicle performance. An automatic tensioning device is being designed in-house.

Roadwheel with replaceable tire - the assembly includes a stamped-steel roadwheel, non-bonded rubber tire, and a steel wear-ring/tire retainer. Benefits include field replacement of tires and elimination of depot rebuilding. Roadwheel assemblies have been fabricated and laboratory tested, and are being field-tested on the M113.

ADIABATIC DIESEL ENGINE

The goal of the adiabatic diesel engine program is to apply high-temperature, insulating materials within the combustion system of a diesel engine to allow a drastic reduction in lost heat to the cooling and exhaust systems.

Advantages of the adiabatic engine include virtual elimination of the convential cooling system, a 30% improvement in fuel economy over current diesel engines, and a 40% reduction in engine system size and weight. Elimination of the entire engine cooling system can produce a quantum jump in engine reliabilty and maintainability. Over 50% of engine

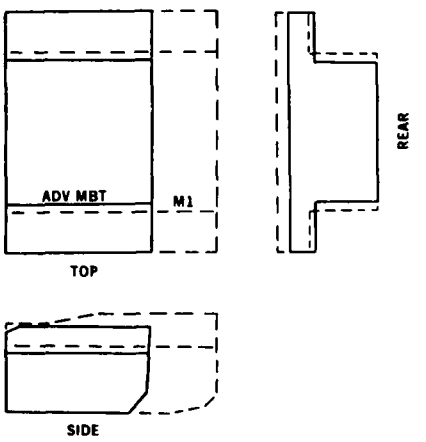
failures in heavy duty vehicles are attributed to cooling system related items. High-temperature engine operation results in smoother combustion, less noise and improved multifuel characteristics.

Extensive feasibility testing has been performed on both single-cylinder and multi-cylinder engines. Multi-cylinder engine performance levels of 0.285 LB/BHP-HR (30% improvement over conventional diesel engines) at 450 HP have been attained. Over 500 hours of multi-cylinder operation have been succesfully accomplished. An early version of the Adiabatic Uncooled Engine has been installed in a military 5-ton truck. The vehicle has accumulated over 3000 miles of road testing to date without any engine failures. Its advantages include elimination of the conventional cooling system, elimination of 361 individual parts, significant fuel economy improvement, reduction in size (20 ft^3) and weight (338 lb.), reduction in vibration and noise and improved cold start characteristics. Design and procurement of long lead time items for the next generation of Adiabatic Engine in the 600-750 HP power range is continuing, with emphasis on compactness, performance, and manufacturing practicality. An on-going program for the Adiabatic Engine Program is the "minimum friction" Adiabatic Engine. This engine minimizes friction using components such as gas bearings, "ringless" pistons, low friction "dry" ceramic bearings and solid lubricants. The engine is projected to incorporate all the advantages of the current Adiabatic Engine, plus further improved fuel economy to 0.25 LB/BHP-HR BSFC and elimination of the engine oil system. Initial component integration of the minimum friction Adiabatic Engine is scheduled for 1983.

ADVANCED INTEGRATED PROPULSION SYSTEM

A three-phase program has been initiated to develop concepts for a propulsion system for a heavy tracked combat vehicle for the 2000 time frame. The program integrates all systems to include engine; transmission; final drives; cooling systems; air filtration; auxiliary power; diagnostics, prognostics and maintainability; inlet and exhaust ducting; infrared, noise, smoke signature; batteries, fuel storage; mounting; and other ancillary equipment. The prime goals are total system volume reduction, lower fuel consumption, fuel tolerance, and improved RAM-D. The figure shows the volumetric target of the program: a one-third improvement in density compared to M1 tank engine. Six contracts were awarded in this phase: Cummins Engine Co., General Electric, Williams International, Teledyne Continental Motors, Garrett Turbine Engine Co., Detroit Diesel Allison.

The second phase will begin in FY84 and will be a two-contractor technology demonstration. Hardware will be fabricated and tested. Phase three, with one contractor, will complete advanced development and prepare the propulsion system for hand-off to the appropriate combat vehicle program manager.



MBT PROPULSION SYSTEM COMPARTMENTS

HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE (HMMWV)

The High Mobility Multipurpose Wheeled Vehicle (HMMWV) is a light, highly mobile vehicle consisting of a 4x4, 1¼-ton common chassis and various kit applications for joint service vehicle roles. These roles include weapons carrier, communications vehicle, utility vehicle, ambulance and target acquisition vehicle. The HMMWV is to replace the following vehicles: (a) Truck, Utility, ¼-Ton, 4x4 M151 Series: (b) Truck, Platform, Utility, ½-Ton, 4x4 M274 Series; (c) Truck, Cargo, Commercial, 1¼-Ton, 4x4 and 4x2 M880 Family (d) Truck, Cargo, 1¼-Ton, 6x6 M561, and (e) Truck, Tactical, Ambulance 1¼-Ton, 6x6 M792. HMMWV vehicles will have a diesel engine, automatic transmission, run-flat tires and be able to accelerate from 0 to 30 miles per hour in six (desired) to eight (required) seconds with a 300-mile crusing range. The vehicle operating profile will be 40 percent cross-country, 30 percent paved highway and 30 percent secondary roads. To the maximum extent possible, existing military or reliable commercial components shall be used.

Contracts were awarded to three contractors on 1 Jul 81 to design/build 11 prototypes each. Vehicles were delivered for testing on 27 Apr 82. An Integrated Development/Operational Competitive test was conducted and completed during FY82. Additional follow-on testing is planned for FY83 and contracts are scheduled to be awarded on 1 Feb 83 for initial production on a five year multi-year basis; and for R&D efforts to refurbish prototypes and design additional kits.

ROBOTIC OBSTACLE BREACHING ASSUALT TANK (ROBAT)

System responsibility for the ROBAT was assigned to TACOM in May 1982 by DARCOM. Schedules and cost estimates have been prepared for R&D prototype in-house design, fabrication, production, and fielding. Execution of this mine clearing vehicle program awaits allocation of funds.

M989 - 11-TON HEAVY EXPANDED MOBILITY AMMUNITION TRAILER (HEMAT)

The HEMAT is a heavy duty tandem axle trailer designed to carry four Multiple Launch Rocket System (MLRS) pods or various ammunition pallet configurations. The HEMAT is the companion trailer for the HEMTT - M985 Heavy Expanded Mobility Tactical Truck. The trailer is also compatible with the Self Propelled Loader Launcher (SPLL - a track vehicle) in case of emergency. Miller Tilt-Top built 18 vehicles prior to stopping production due to financial difficulties. The vehicles have been tested at the Waterways Experiment Station, Savanna, GA and Ft. Sill, OK. A novation agreement has been finalized for Stowell Industries to build HEMAT trailers under the terms of the Miller Tilt-Top multiyear contract. First production delivery from Stowell Industries is scheduled for Dec 82.

M871 SEMITRAILER, 22½ TON

The M871 is a 30-foot tandem axle flatbed semitrailer capable of carrying containers, missiles, or breakbulk cargo weighing up to 22½ tons. The M871, along with the M872, will replace the M127 Semitrailer fleet. The prime movers are the 5- and 8-ton military truck tractors and the commercial International 4070A truck tractor. The M871 trailer with the M915 truck tractor has been operational in Germany since Feb 82. A full release of the M871 trailer was approved in Jul 82. A total of 3166 trailers will be built under the current five year contract.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

DOLLY SET, LIFT TRANSPORTABLE

The Dolly Set, Lift Transportable, XM1022 will lift, transport and emplace the family of Rigid Wall Shelters currently being procured by Natick Labs. The dolly is an NDI item designed to carry a gross payload of 15,000 lbs. It will be utilized by the Surgeon General, Aviation Maintenance Activity and other Army Agencies. Multi-Service Application is anticipated.

The program was assigned to TACOM in Sep 81. Since that time Natick Labs has completed development testing on the shelters which provided information on prototype dollys from two companies; a market survey has been initiated; and a draft specification has been written. Type classification is scheduled for Feb 83 with a procurement award expected by Nov 83.

ADVANCED TECHNIQUES FOR ELECTRICAL POWER MANAGEMENT, CONTROL AND DISTRIBUTION SYSTEMS (ATEPS)

Testing of the ATEPS microcomputer-controlled multiplex system in a baseline M1 tank hull was completed in FY82. Test results established ATEPS' feasibility. Testing included 40 hours of static performance testing and a five hour TACOM test track test. The design of a two terminal turret system was completed. This system consists of a fire control remote terminal and gunners/crew terminal, which interfaces with the current five terminal hull system. Fabrication of the two terminals is in progress.

FY83 plans provide for the addition of a third terminal which performs both remote terminal functions and crew terminal functions; it will also upgrade the existing M1 ATEPS Prototype Hull System. The latter task will provide more reliable engine control capabilty for the turret test phase.

FMS TECHNICAL SUPPORT ACTIVITIES

The Government of Egypt signed a Letter of Agreement in March 1981 to extend the operational life of an anti-aircraft defense system. TACOM is providing the management and technical expertise to the contractor for the vehicle primary power supply system.

1,000 HP ADVANCED DIESEL ENGINE

The 1,000 HP Advanced Diesel Engine program objective is to improve the diesel engine's horsepower-to-weight ratio and fuel economy by applying diesel technology to existing commercial-based engines. The goal is to develop a 1,000 horsepower engine. The advanced technology being applied includes a high-pressure, high-efficiency turbocharger, a turbocompound system, low-compression ratio and an intake manifold burner to aid in cold-starting and light-load operation.

Initial testing of a diesel engine test rig was completed during second quarter FY82 at TACOM. The rig was a modified version of the Cummins VTA-903, 8 cylinder, 500 HP diesel engine used in the M2/M3 Infantry Fighting and Cavalry Fighting Vehicles. The turbocompound engine successfully attained 1025 HP output at 3200 RPM. The observed fuel consummption at this power level was 0.350 LB/HP-HR.

The engine was sent back in 3rd Qtr FY82 to Cummins Engine Co. for further development and testing. Through Sep 82 a total of 355 test hours have been accumulated on the engine. Future work includes development of a new cam and a variable injection timing system to enhance engine performance throughout its entire speed range. Additional work will include a 200 hour durability test as well.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

HYDRAULIC BRAKE RETARDER

The present multiple wet-plate friction-type braking systems have been pushed to the limits of friction brake technology. As a result, increases in braking capacity can only be obtained by adding more plates or by increasing their diameters, either of which must be accompanied by increased application forces. This promotes early plate failure.

Hydraulic retarder-type braking systems solve the increasing brake capacity problem while avoiding the plate system problems mentioned above.

The hydraulic retarder operates on the principle of change of momentum of oil as it circulates in a toroidal chamber, much like the action of a torque converter. The initial hydraulic brake retarder design, hardware procurement and shake-down testing have been completed. Performance data resulting from the retarder testing has been used in making a computer synthesis of vehicle and cooling system behavior under varying conditions of operation. The resulting retarder will be incorporated into the 1,000-HP transmission design.

1500 HP DIESEL ENGINE DEVELOMENT

The objective of this program is to continue development of a diesel engine until the Army ground turbine engine (AGT-1500) operates satisfactorily in the M1 tank.

During 1982 two M1 pilot vehicles were modified with diesel powerpacks. The first vehicle was delivered to the Government in July 1982. It was tested for infrared signatures at Grayling, Michigan, then shipped to Yuma Proving Ground for desert testing. The second vehicle was delivered to the Government in mid-October 1982 and shipped to Aberdeen Proving Ground for 6000 mile RAM testing.

A 1000 hour dynamometer durability test, aborted last year after 219 test hours, was restated in 1982 after further engine development. This test is now nearing completion with more than 800 durability test hours logged. Both of the vehicle engines mentioned above and the 1000 hour test engine are equipped with VAT turbochargers and fully automatic VAT controls.

ENGINE CONCEPTS FOR ALTERNATIVE FUELS

This task continues efforts to establish a technology base for development of alternative fuels combustion systems for military ground vehicle engines. In FY85, several areas of new technology will be investigated:

0 Microprocessor Controlled Fuel Injection

0 Ancillary Componentry Modulation

0 Sensors

0 New Alternative Fuel Combustion Processes

0 Engine/Fuel Compatibility Provisions and combination of the above to develop full authority microprocessor controlled combustion systems.

The current effort includes investigating the complete spectrum of microprocessor fuel injection control systems to exploit their precision and flexibility in using alternative fuels; analyzing microprocessor modulation of ancillary componentry, such as turbomachinery; evaluating new sensor techniques, with emphasis on combustion quality sensors; investigating all known combustion processes suitable for alternative fuels, as well as new processes; and assessing engine/fuel compatibility with respect to material, wear, lubricity, design tolerances, and similar factors.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

GROUND LAUNCHED CRUISE MISSILE (GLCM)

Designs were completed for the fabrication of GLCM Driver Training Vehicles (DTVs). This included storage and fuel boxes, DTV dummy loads, Launch Control Center mounting brackets, driver training kits, launcher container, shelter mounting brackets, fiber optics box container, simulated launcher assembly, and ballast modules. Fabrication started and portions of the Transporter Erector Launcher (TEL) and Launch Control Center (LCC) vehicles were completed. Project completion, in FY83, is proceeding on schedule.

ADVANCED DIAGNOSTICS

The Advanced Diagnostics program will provide the forward support mechanic a simple and effective means of diagnosing vehicle malfunctions rapidly.

In FY82, the Advanced Diagnostics program initiated a feasibility study of a Simplified Test Equipment (STE) system incorporating noncontact/minimal contact diagnostic test technology, as well as complete STE/ICE test capability, into a reprogrammable test set. Such a test set provides measurements for use in diagnosing tank-automotive components or subsystems with a minimum of physical contact between the vehicle and the test system.

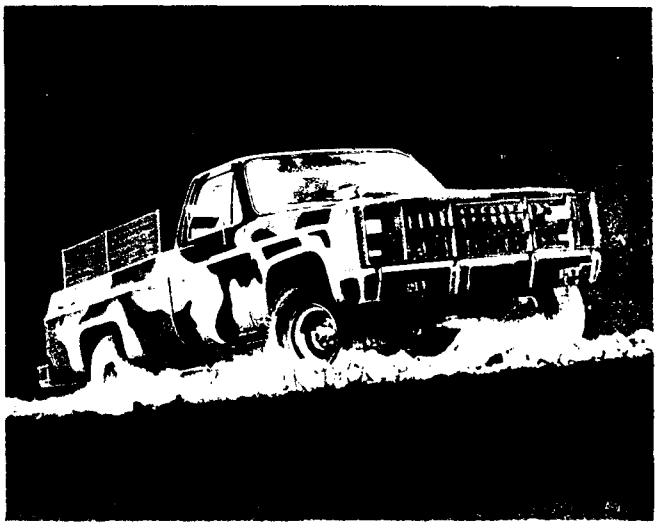
The Advanced Diagnostics program will continue to investigate advanced diagnostic techniques concerned with noncontact sensor technology for gas turbine engines, fuel injection systems, and microprocessor-based engine controllers. Using a modified STE/ICE or limited STE-X test set, program members will test the diagnostic capabilities of the Variable Reluctance Sensor and microwave sensor to measure engine speed, turbocharger condition, turbocharged engine power and cylinder fault identification.

COMMERCIAL UTILITY AND CARGO VEHICLE

The Commercial Utility and Cargo Vehicle is intended to fulfill the Army light-load requirements (cargo, utility, and ambulance) for essentially rear area roles. These vehicles will replace part of the M151A2 ¼-ton truck family and all of the M880/890-series trucks. TACOM will procure the various derivative vehicles, using the production base of a commercially available diesel engine driven 4x4 vehicle for a family of trucks with common configurations and logistic benefits.

Specific Army requirements include blackout lights, STE/ICE, NBC, driver weapon security, and military towing provisions. Applicable kits include winterization, machine gun, 24-volt electrical system with 100-amp capacity, troop seats, cargo box cover, and communication shelters.

A multi-year procurement contract was awarded 23 July 1982 to GM.



TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

AUXILIARY POWER UNIT (APU)

The APU development resulted in a gas-turbine-engine-driven 10 kw generator set capable of supplying 28VDC power to the M1 and other combat vehicles. The first phase of development was concluded with the laboratory and vehicle tests of the five prototype units. Good results were achieved with APU operation and APU-assisted main engine starts in the M1 were obtained down to -70oF in under a minute with minimal battery preheating and precharging.

The next phase of development effort will upgrade the unit to a 15 kw output using commercially available components. A 15 kw unit would allow "battery unassisted" engine starts for the M1 at low temperatures.

A program will be initiated to silence the APU and further reduce its packaging volume within an M1 tank. This effort is aimed at meeting the Army's needs for a much reduced signature and space availability for fuel.

SMALL UNIT SUPPORT VEHICLE (SUSV)

The SUSV is a helicopter-transportable vehicle that can traverse all kinds of terrain, year-round, either on-road or cross-country. The SUSV is intended to support mobile units by transporting equipment, ammunition and supplies in northern and mountainous regions. The vehicle was type classified as the "Carrier, Cargo, Tracked, 1½ ton, M973" as a result of the 10 - 11 February 1982 In-Process Review.

The market survey conducted in 1981 resulted in the nomination of one candidate vehicle which meets the SUSV requirements. This vehicle is the Swedish built BV206 tracked vehicle. An approved sole-source procurement process is underway. Contract award and vehicle production will commence in FY83.

EVALUATION OF GT-601 COMMERCIAL VEHICULAR GAS TURBINE ENGINE

Feasibility of the Garrett Corp GT-601 engine was investigated in a 20-ton tracked combat vehicle using an Allison X-300 transmission without the torque converter (not needed with this engine). Operational charactristics of the system were determined and later used in validation of a computer modelling program which can provide alternate engine comparison data for future engine selection. Final test phase is now in progress involving maneuverability, increased air cleaner blockage, and engine braking effects. These are being run for comparison with the M1 tank.

COMPOSITE ARMOR

Composite armor systems have been evaluated against the medium caliber (23 & 30 mm) high-velocity kinetic-energy ammuniton. Efficient, lightweight armor systems of louver type design, have been developed. Methods have been developed for attaching the armor to lightweight vehicles.

A design using automotive sheet steel was established to defeat small flechettes, splinters and fragments. The design was both weight efficient and economical.

NOISE CONTROL

During FY82, the near-field single microphone scanning technique was applied to an M113A1 armored personnel carrier. Sound pressure fields were mapped for both interior vehicle sides and door. These sound maps were used in low frequency noise location.

The effect of a spall supressive armor system on the interior noise field of an M113 was also investigated. Results indicate that the spall liner lowers the interior noise field by an average value of 2 dB(A) for several vehicle test conditions.

TECHNICAL ACHIEVEMENT BY PROGRAM BREAKOUT

ADVANCE COMPOSITE MATERIALS & STRUCTURES

Prototype units of various components--frame, wheels, leaf springs, and drive shafts--have been manufactured from fiberglass/epoxy resin and graphite/epoxy resin systems. The frame is manufactured using a fiberglass/graphite hybrid in the frame rails with fiberglass frame cross-members and wheels using both chopped and directional long fibers. The frame is currently undergoing testing at the Army Mechanics and Materials Research Center. All components are being assembled into an M939-series 5-ton cargo truck; completion is targeted for 2nd Qtr FY83 with a limited field evaluation to follow.

LASER HEAT TREATING - M2/M3 FIGHTING VEHICLE SYSTEMS

In FY82, a program was started to establish production processes for M2/M3 Fighting Vehicle track and suspension components which will use lasers to heat-treat selected high-wear areas. With laser technology, both the location and the depth of the area to be treated can be controlled precisely. There will be minimal distortion of the part due to the heat treating process. A manufacturing saving of approximately 5% through reduced machining and an approximate 20% increase in service life of the component can be achieved.

XM1000 - SEMITRAILER LOWBED 70 TON

The XM1000 is a non-development item (NDI) 70-Ton Heavy Equipment Transporter Semitrailer capable of transporting the main battle tank and other heavy tracked and wheeled vehicles. Technical feasibility testing and a Military Traffic Management Command state highway survey have shown that a Western Heavy Hauler type trailer will not satisfy both highway and tactical operating requirements. As a result of these findings the XM1000 program has been redirected. The program personnel are now looking at the feasibility of adopting commercial trailers to meet the tactical operating requirements. Two commercial trailers are now being procured and will undergo technical feasibility testing in FY83.

LASER SURFACE HARDENED COMBAT VEHICLE COMPONENTS

Recently completed research demonstrated that surface hardening requirements for T-142 track end connectors and centerguides can be adequately met by heat treatment with a CO_2 laser beam. The necessary parametric limits and controls to achieve desired hardening patterns for the selected track components were established. One important achievement is the development of unique methods of laser heat treating by using mirrors or a cylindrical lens. These important developments have opened new dimensions in laser heat treatment by utilizing low laser beam power densities to achieve large casing geometries without surface melting.

M2/M3 FIGHTING VEHICLE SYSTEMS COMPOSITE WEAPON STATION BASKET

The program to manufacture weapon station baskets which use composite manufacturing processes reduces fabrication costs by approximately 10%. Current production fabrication consists of fixturing over 100 parts prior to welding. A production composite process will reduce the piece part count to 10, thus lowering fabrication costs without affecting component performance. Other benefits expected are greater corrosion resistance, lighter weight, and field repairability.

LIGHTWEIGHT SADDLE FUEL TANK

Fabrication of 5-ton cargo truck lightweight fuel tanks for engineering evaluation was completed in February 1982. Testing is in progress at Yuma Proving Grounds (YPG), AZ, at the Tropical Test Center (Panama Canal Zone) and at the Cold Region Test Center (CRTC) in Ft. Greely, AK. Assessments of the lightweight fuel tank are scheduled for October 1982 at YPG and April 1983 at CRTC. All work is scheduled for completion in FY83.

The lightweight saddle fuel tanks were fabricated for the 5-ton M809-series cargo trucks, and are fully interchangeable with existing metal fuel tanks used on the M809- and M939-series cargo trucks. The weights of the lightweight fuel tank and existing metal fuel tanks, fully assembled and without fuel, are as follows:

- Lightweight Fuel Tank (M809-series cargo truck): 78.8 lb. (35.7 kg)
- M809 Metal Fuel Tank: 106 lb. (48.1 kg)
- M939 Metal Fuel Tank: 209 lb. (94.8 kg)

The fuel capacity of all fuel tanks mentioned above is 78 gallons (295 liters).

FIRE CONTROL/WEAPON SYSTEMS INTEGRATION

An objective of this program is to support fire control technologies that have potential application to current and future TACOM combat vehicle programs.

During FY82, the Full Scale Simulation Facility, which has the capacity to shake entire vehicles, was used to investigate High Mobility/Agility Vehicle (HIMAG) stabilization performance capabilities for input into the Mobile Protected Gun MPG program. Several levels of gun unbalance tests were conducted to evaluate system performance of fire-on-the-move capability.

In a separate program, TACOM provided funding support to Human Engineering Laboratory for completion of the Fire Control Research System.

TURRET AND WEAPON STATION INTEGRATION

The turret and weapon station integration program provides a coordinated effort for the development of advanced weapon station components, subsystems and techniques resulting in demonstrable state-of-the-art turret/weapon integration. Development activities during FY82 included Fluidic Tank Turret Stabilization and Position Control System.

FLUIDIC TANK TURRET STABILIZATION

A brassboard model of a pneumatic rate sensor was developed, resulting in redesign of the pressure controlled oscillators, which improved rate resolution and linearity. Other design changes in the fluidic amplifiers, vane pump and electronics will reduce noise and improve range and reliabilty. Delivery of the sensors for vehicle (M1 tank) tests is scheduled for second quarter FY83. These tests, to be performed during FY83, will provide data to document the improvement in stabilization of the M1 tank turret system. Successful completion of this phase of fluidic development will provide a basis for a more extensive development of an all-pneumatic gun stabilization system for combat vehicles.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

TURBINE ENGINE CERAMIC COMPONENTS

Studies have been made of heat transfer, thermal stresses, cooling air flow and turbine rotor configuration design at a turbine inlet temperature of 2650oF. Thermal barriers provided by a ceramic coating applied under metallic blades reduced the amount of heat flow to the metal and consequently reduced the cooling requirements of the metal. Increased operating temperature and reduced cooling air flow increased engine efficiency. The final phase of this project is in progress now. It will include fabrication of complete ceramic coated turbine stator and rotor, both of which will be evaluated in a test engine. Project is slated for completion in FY84.

TRACK FOR 15- TO 18-TON VEHICLES; XT-150

This track is a double pin, extended end connector design with quick disconnect/replaceable chevron pads. Second generation track has been tested from 6,000 to 10,000 miles at several CONUS locations with good results. Experimental track tests using various fabrication methods are scheduled to begin at Nevada Automotive Test Center.

TRACK FOR 20- TO 40-TON VEHICLES; XT-154

This track is a double pin, extended end connector design with quick disconnect/replaceable chevron pads. The first generation of the XT154 track, suitable for self-propelled artillery, FAASV, and the Bradley vehicles has been tested at Aberdeen Proving Ground for 2,000 miles. Second generation track is being fabricated and is scheduled for vehicle test on an M110 SP howitzer at Yuma Proving Ground, on an M108 gun at Milford, and on an improved M109 SP howitzer and M2 Infantry Fighting Vehicle at Aberdeen Proving Ground.

M1/M60 NEAR-TERM TRACK IMPROVEMENT PROGRAM

A program has been scheduled to improve the M1 and M60 tank tracks. This includes the following:

- 0 Fabrication and vehicle test of C1046 steel pins, which will reduce track pin breakage on the M60 vehicle.
- 0 A study of fasteners, which may improve reliability and maintainability of track pads, end connectors and center guides.
- 0 Procurement and vehicle test of M1 full area pad track, which will improve track life.
- 0 Procurement and test of various rubber compounds which will improve the track life on the M1 vehicle.
- 0 Development of a laboratory test which will determine blowout resistance of various compounds.
- 0 Development, fabrication and vehicle test of a composite track pad for M60 and M1 vehicles which will reduce blowout and cutting/chunking.
- 0 Development and vehicle test of a winter-traction device.

POSITION CONTROL SYSTEM (PCS)

The PCS involves a displacement sensitive trackball concept for controlling the turret/weapon drive system. PCS tracking peformance tests were conducted on the TACOM Dynamic Ride Simulator at the end of FY82. Analysis of the test data is in process.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

MECHANICAL FASTENING OF COMPOSITE MATERIALS

Extensive use of fiber composite materials in both structural and non-structural applications will require a variety of joining techniques. Mechanical fasteners, such as bolts, screws, and rivets, are inexpensive, simple and should be available to designers along with adhesives and other, more sophisticated, joining techniques. In microscopically homogenous isotropic materials, such as metals, the effect of mechanical fasteners on local stress distribution and stress concentration is well knowm; these local effects die out rapidly away from the fasteners. Such effects are less well understood in composites, where local stresses may be channeled over long distances, and where stress effects depend strongly on structure.

TACOM awarded a contract to Michigan State University in Aug 82 to perform experimental and analytical studies on stresses due to mechanical fasteners in fiber composites. Results of these studies will assist designers in establishing fastener patterns, local reinforcement, and structural requirements where composites are selected.

M2/M3 FIGHTING VEHICLE SYSTEM - ADHESIVE TECHNOLOGY

An FY82 project has been undertaken to establish manufacturing methodology using adhesives in the production of the M2/M3 Fighting Vehicles. Many interior hull components (for example, footman loops) are currently attached by labor-intensive and costly welds. Many small interior hull components now can be attached with adhesives, thus yielding an approximate cost savings of $200 per vehicle. Other advantages include field repairability, reduced joint corrosion and reduced component deformation.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

MOTORCYCLE: XM1030

The Motorcycle Program will follow a typical NDI acquisition cycle. The motorcycle's primary mission will be message/courier service and will replace some M151 trucks in certain roles. It will be an on-off road vehicle, not to exceed 300 lbs., with an engine displacement of 250cc or higher. The letter requirement for miltary motorcycle was approved in Sep 81. A Technical Feasibility Test was conducted between 17 Jun and 30 Sep 82 on 15 motorcycles (three motorcycles each from five different manufacturers).

12-VOLT VEHICLE LIGHTING

The 12-volt lighting project will provide a system for adapting commonly available 12-volt lamps for use in 24-volt military vehicles. This system will eliminate the requirements for shock-mounting lights with 24-volt lamps (24-volt lamps are prone to fail due to the extra fragile filaments). Vehicles at TACOM and Keweenaw Research Center, at Houghton, MI, continue on test. In addition, three high-mileage test vehicles at Aberdeen and the Ohio Test Center are employing 12-volt lighting. These tests will continue for a minimum of 20,000 miles. Targeted completion of the evaluation is 2nd quarter FY83.

SELF-THREADING FASTENERS FOR THE M2 and M3 FIGHTING VEHICLE SYSTEMS

An FY82 effort has been undertaken to establish production techniques for self-threading fasteners on the M2/M3 Fighting Vehicles. The advantages of these fasteners include elimination of aluminum hole tapping, greater fastening forces, and compatability with standard fasteners (should self-threading fasteners not be available during depot rebuild and field repair). Through the reduction of component rework--caused by conventional hole tapping errors, broken taps and cross threading in aluminum--this program has the potential to reduce manufacturing costs by approximately $1,000 per vehicle.

GEAR DIE DESIGN

Gear manufacturing processes are highly specialized due to the complex geometry and high accuracy requirements of gear teeth. Traditionally, bevel gears are manufactured using highly specialized cutting and grinding machines. Precision forging of bevel gears offers considerable advantages because this process reduces the machining losses and increases the fatigue life of the gears. In FY82, ten-inch diameter spiral bevel gears were successfully forged to net shape, thereby eliminating the need for machining, which represents 40% of the end item cost if machined from blanks.

LOCKING ADHESIVES AND SEALANTS

The first phase of this two-phase program validates the use of commercially available anoerobic adhesives to replace lockwashers and other mechanical devices. The sealants provide improved reliability and performance. These products are evaluated through laboratory and field tests on selected combat vehicles, engines and transmissions. The second phase will consist of chemical analyses to determine sealant shelf life and correlate it with mechanical properties, determine qualifying requirements, revise military specifications, and prepare quality control procedures and quality assurance factors.

MACI: WIRING HARNESSES FOR COMBAT VEHICLES

An investigation was conducted to determine whether there exist improved commercially available materials which will extend the service life of wiring harnesses in combat vehicles. Materials were selected and tested in laboratories under environmental conditions specified for the M1 Tank. The present harness contractor is currently fabricating wiring harnesses for field testing.

A second part of this effort is to study the current M1 tank electrical connector system, and to propose a smaller family of electrical connectors for use on the M1 tank and other combat vehicles. The proposed electrical connector family will be accessible by a common Master adapter connector for test purposes. Using such a connector system will greatly simplify the diagnostics hardware of future military vehicles.

HYDROMECHANICAL TRANSMISSION CLUTCH

Investigation of improved materials, component geometry and high hydraulic oil operating pressures was completed in FY82. Results of this investigation will be applied to configuring the HMPT-900 transmission, which is now entering the concept study phase.

CREW PROTECTIVE SEAT

The work on analyzing the man-seat-frames, typical in a combat vehicles, has been finished. Computer simulations of the shocks, as in a mine blast, were made of the man-seat-frame system.

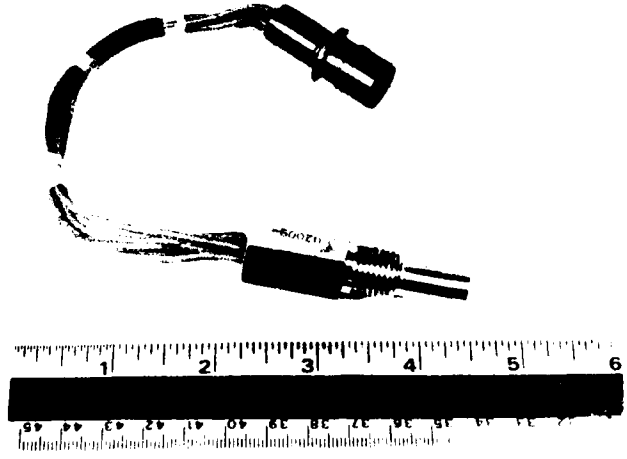
A final report has been received. Recommendations will be made on how to improve the seat so that the driver can survive such an environment.

MACI SUPPORT FOR STE/ICE

The objective of this program is to adapt commercially available sensors and transducers for the STE/ICE system emphasising on-board equipment using Diagnostic Connector Assemblies (DCAs).

Present efforts are directed toward optimizing design of the Variable Reluctance Sensor (VRS), a device that allows measurement of engine speed, top dead center or cylinder identification without physical attachment to the vehicle. The present program also includes a Producibility Engineering and Planning program for VRS, field evaluation of VRS prototypes, expanded sources for the pulse tachometer, and changes to the pressure transducer and pressure switch drawing packages (to widen competition).

Future efforts will be directed toward applications for Hall Effect Current Sensors, and evaluations of sensors for turbine engine diagnostics, and diesel engine fuel injection timing and injection pressure.

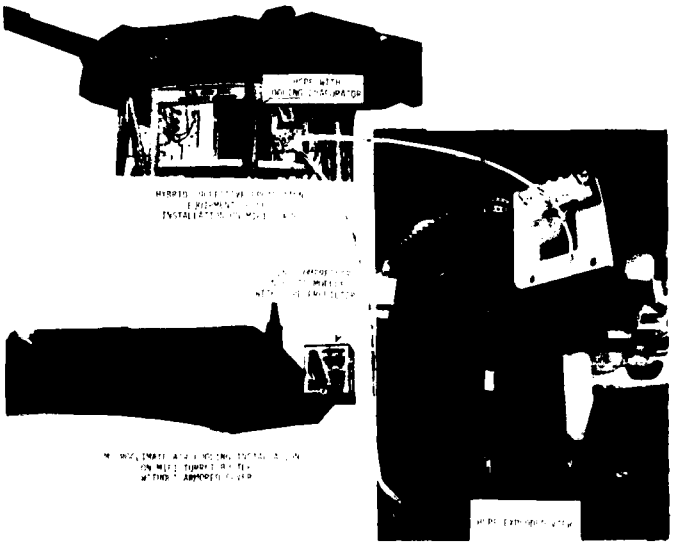


TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

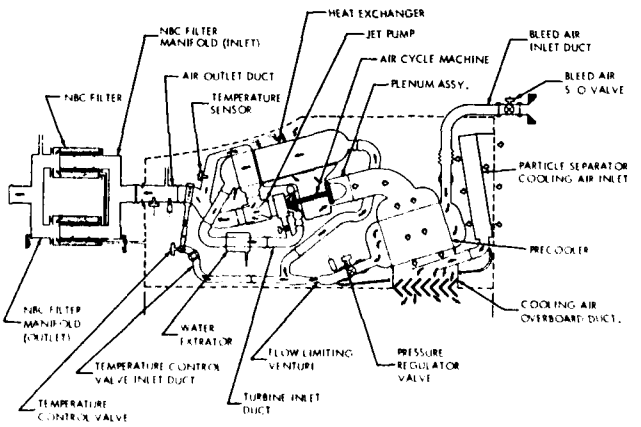
NBC DEVELOPMENT PROJECT OFFICE

NBC SYSTEMS INTEGRATION

From the hybrid collective protection equipment (HCPE) Development Project, a successful prototype trial installation was completed for the M1E1 Tank. The HCPE system was comprised of a Honeywell HCPE rated at 200 CFM and a vapor cycle, microclimate air cooling system developed by Engineered Air Systems. The air cooling system was rated at approximately 7,200 Btu/hour and derived its operational capability from surplus hydraulic power from the turret drive system. The HCPE and cooling evaporator were stowed in the turret basket forward of the loader, in a place previously occupied by an ammunition rack and turret network box. The HCPE pre-filter section, as well as the air cooling system compressor/condenser module, was applied externally to the turret bustle area. The installation was operationally demonstrated at the 9 Jul 82 General Officer NBC Decisional IPR.



The second accomplishment occurred through the conceptual efforts of the NBC Development Project Office and interactions with industry. The Air Research Manufacturing Corporation presented an air cycle NBC/cooling approach to the M1 Tank PMO. This approach used turbine engine bleed air as prefiltered air for an HCPE capability as well as for off-the-shelf cooling hardware for the crew microclimate air cooling system. Through the combined efforts of the contractor, M1 Tank PMO, General Dynamics Land Systems Division and the NBC Development Project Office, a prototype was installed on the M1E1 tank test vehicle. The system is compact, with most installation packaging on the vehicle left sponson except for the gas-particulate filter elements. The system provides 200 CFM of cooled, prefiltered air to two standardized composite gas-particulate filter elements located on the periphery of the turret basket. Currently, this approach is preferred by the M1 Tank PMO as a solution to the combined NBC hybrid protection and crew cooling problem.



MATERIALS COMPATIBILITY WITH CHEMICAL WARFARE AGENTS

The US Army Materials and Mechanics Research Center has been funded over the last several years to conduct a program on the interaction of chemical agents with non-metallic materials to guide the selection of agent resistant materials for Army combat vehicle weapon systems. Solubility and diffusiveness of chemical agents in selected materials are being calculated from data obtained through testing using chemical agent simulants. Solubility and diffusiveness of many materials have been determined. Live agent testing will be started in FY83 to determine if the simulant selections are appropriate or if additional work to find new simulants will be necessary. The end result will be information on test materials which will allow vehicle design engineers to choose or test materials which are resistant to chemical agents, yet are structurally acceptable and affordable for weapon systems application.

Work on Chemical Agent Resistant Coatings exploiting polyurethane paint as an impervious coating for combat vehicle exteriors has been successfully completed. Polyurethane paint conforming to MIL-C-46168B offers resistance to chemical warfare agents as well as to decontamination solutions, particularly DS2. A special IPR recommended adoption of polyurethane paint as the preferred paint coating in lieu of the alkyd paints currently applied. Work has been transitioned from the R&D Center to TACOM.

NBC COOLING

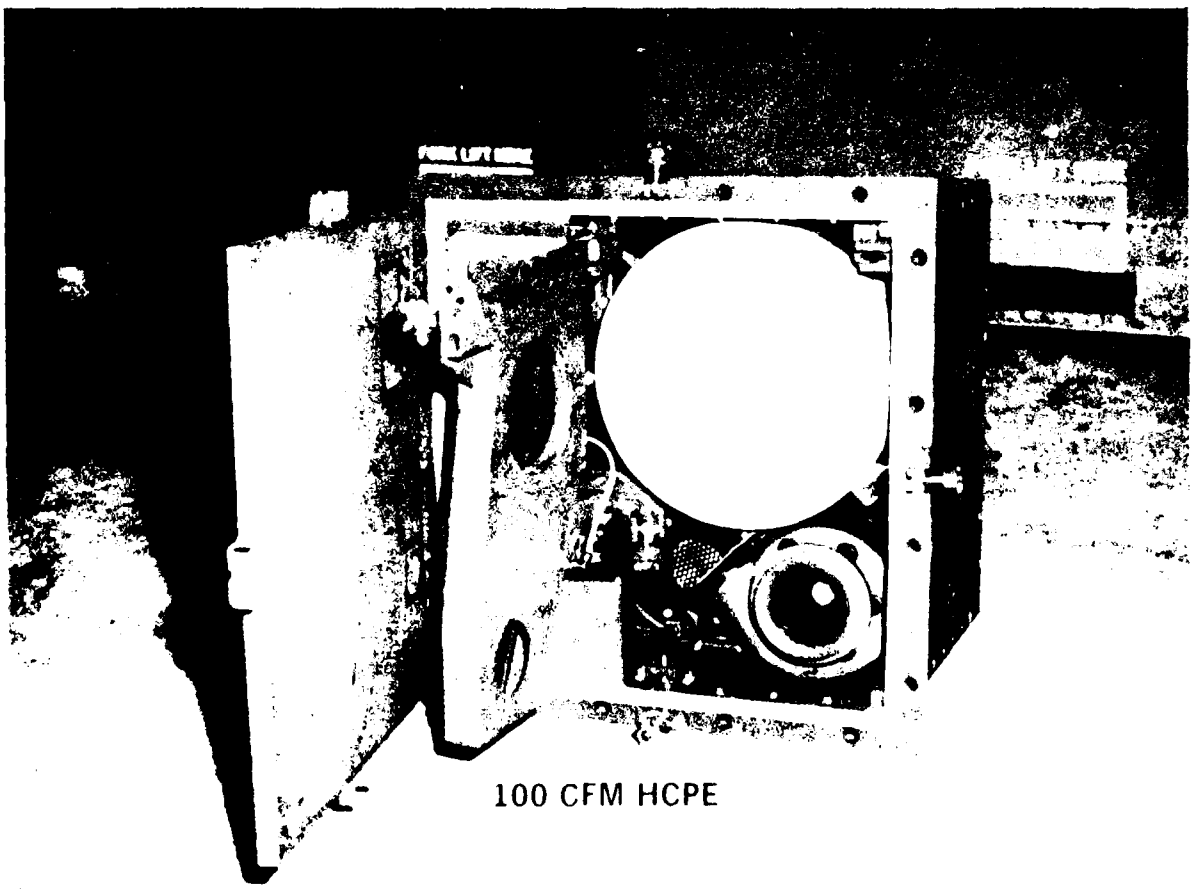
The NBC Development Project Office prepared and submitted to higher headquarters a comprehensive plan for Development and Fielding of NBC/Cooling Systems for Armored Vehicles. The plan required extensive coordination with the Mobility Equipment R&D Command, Natick Labs and TRADOC, and involved an accelerated acquisition cycle. The plan offered a strategy in streamlining typical acquisition cycles through the prequalification of a wide variety of cooling hardware and driving mechanisms. The hardware availability and technical data packages will allow vehicle PMOs to mix, match and select components best suited to the particular vehicle in question. NBC cooling system type classification depends on the vehicle type classification. The plan has been approved by DARCOM and DA. The qualification plan is planned to be instituted in FY83.

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

HYBRID COLLECTIVE PROTECTION EQUIPMENT (HCPE)

HCPE represents an advancement in the state-of-the-art in nuclear, biological and chemical (NBC) protection for US armored vehicles. It provides the combined benefits of contaminant-free overpressure with the flexibility of ventilated facepiece protection for emergency use in an NBC environment. HCPE is intended for those vehicles performing missions in which personnel are required either to remain inside for long periods or get in or out of it quickly.

HCPE prototype phase has been completed and engineering design stage (EDT) I phase of development has continued. Efforts during EDT I were directed toward development and testing of a 100 CFM HCPE, an M1E1 tank specific (200 CFM) HCPE and a 300 CFM HCPE. The 100 CFM unit will be used to validate the system and the components. Components specific to the M1E1 tank and 300 CFM unit will be tested individually. It is anticipated that qualified HCPE components will be available for Project Managers' use in development of individual weapons systems collective protection equipment within one year. This offers the PM the opportunity to configure the HCPE to offer best integration of the components on his weapon system. The 100 CFM rated, cylindrical, composite gas-particulate filter element will become a qualified standard equipment item.

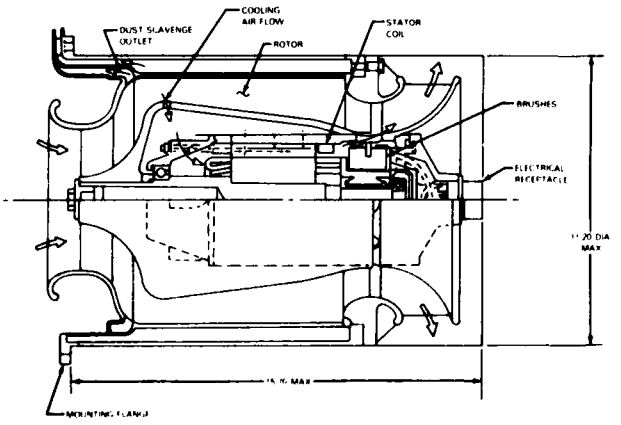


100 CFM HCPE

DUST SEPARATING VENTILATION BLOWER

A contract effort is planned to develop a crew compartment ventilation blower capable of particulate separation. This blower/ventilation system is to be an improvement over the current system in which inertial dust separating tubes must be added to a blower to achieve the same effect. This latter approach tends to be too large for a one-on-one replacement for the current turret ventilation blower employed by M60 and M1 Tank Systems. The objective for the new blower system is to provide two levels of air flow capacity (1200 and 600 CFM), to remove approximately 98% dust, and to be sized to permit a one-on-one replacement for the standard (M60) ventilation blower when used with its silencer. This blower system does not compete with Hybrid Collective Protection Equipment (HCPE) applications. Rather, it is intended to remove radioactive dust contamination and to enhance related life suport systems in those combat vehicles not employing whole compartment protection afforded by HCPE. All required contractual prerequisites through Contract Award Board Approval were completed in FY82. Contract award is planned for the beginning of FY83.

VENTILATION BLOWER/DUST SEPARATOR ADVANCED CONCEPT



TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT

ENGINEERING SUPPORT DIRECTORATE

SURROGATE RESEARCH VEHICLE (SRV)

The SRV is a test bed designed and being fabricated in-house to evaluate various combinations of crew positions within new generations of main battle tanks. The test bed design has been translated into hardware using an M1 chassis/hull. The SRV will have provision for seating the entire crew in the hull or for checking combinations of hull/turret seating. Design and fabrication will be completed during FY83.

LIGHTWEIGHT TOW BAR (LTB)

Lightweight combat vehicle tow bars designed to ease crew handling have been designed, fabricated and tested. Stability problems, encountered during initial LTB testing, have been corrected. The new design for the steel tow bar has resulted in less costly, lighter/stronger tow bars, weighing 53 lbs. each, that can be easily stowed aboard tanks.

LVTP-12 ENGINE DEMONSTRATOR

The power train of a Marine Corps LVTP-12 landing craft has been changed to allow incorporation of an RC-2-3502 rotary engine. The vehicle, in the fabrication shop, was machined for the installation. The project can be completed during FY83 if funding is reinstated.

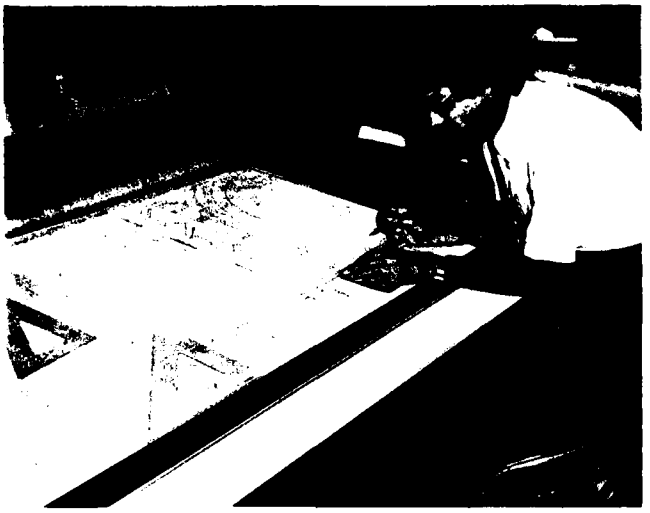
OTHER MAJOR ACTIVITIES

The Engineering Support Directorate was involved in studies to modernize in-house design, fabrication and test support facilities and equipment. Computer Aided Design equipment has been installed. Initial training of personnel was accomplished. An increase in the Special Purpose Equipment funding enabled procurement of some new equipment to replace obsolete items.

Efforts were expended supporting the following projects:

- o Design of a Battlefield Expedient Repair Kit
- o Active Track Tensioner
- o Fatigue Testing of T142 Track Pins
- o Experimental Cone Brake Drum Testing
- o Track Pad Test Machine - Designed/Fabricated
- o Foreign Vehicle Activity, e.g., T-62 Grille repair; hull repairs on a Polish MTLB Carrier
- o M2/M3 Wabnitz Cargo Hatch
- o Simulator (Shaker) Testing: HIMAG, seats
- o NBC - Vehicle Leakage Unit
- o Metrication
- o Fire Suppression Testing - Fixture Design/Fabrication

TECHNICAL ACHIEVEMENTS BY PROGRAM BREAKOUT



FROM DESIGN. . .

. . .TO HARDWARE

ACTIVITY INDICATORS

CATEGORY	CONCEPTS LAB	SYSTEMS LAB	STPO	TOTAL
Technical Articles	1	2	5	8
Technical Papers	5	11	12	38
Briefings		20	1	21
Seminar/Committee Chairmanship		2		2
Patents Issued			27	27
Patent Applications Filed			21	21
Technical Reports	2	9	27	38

FACILITIES

OVERVIEW

The U.S. Army Tank-Automotive Command's R&D Center Laboratories and shops are equipped to develop and support the military vehicle fleet. Research and study are performed here on propulsion systems, surface mobility systems, vehicular components, and materials, from concept through prototype.

The increasing need for the modernization of test facilities and experimental fabrication machine tools has resulted in the decision to prepare an updated master plan for a 5- to 10-year modernization effort. This plan, which includes funding alternatives, will require expenditures of more than $5 million per year.

PHYSICAL SCIENCE LAB

The laboratory has facilities for extensive investigations into vehicle signatures and signature reduction methods. Non-destructive test capabilities include holographic analysis. Mini-computers and remote terminals provide a ready capability for engineering analysis, modeling, and simulation studies. Automated word processing equipment provides the capability to readily retrieve stored technical source and technical report data.

KEWEENAW FIELD STATION:

The Keweenaw Field Station located at Houghton, MI, is managed by the Keweenaw Research Center at the Michigan Technological University. It consists of vehicle maintenance shops, small machine shop storage and office buildings. It houses many types of support vehicles and equipment. A wide variety of R&D work, along with related field testing in support of TACOM's mission, is performed there.

PROPULSION SYSTEMS LAB

Present facilities include nine test cells: two are transmission cells, one is a vehicle cell, and six are for engines. One cell is equipped with a semianechoic chamber. Cell 9 is equipped to test tracked and wheeled vehicles at temperatures up to 160°F, for solar radiation simulation and wind speeds up to 20-MPH.

TRACK AND SUSPENSION LAB

One of the outstanding features of this laboratory is its dynamic simulation capability. Vibration and shock inputs from terrain tapes are fed through hydraulic actuators to the tires, wheel spindles or roadwheel arms. The simulation approaches permit accelerated testing of vehicles and components so that designs can be optimized without time-consuming field testing. Smaller actuators accommodate fatigue tests on components and subsystems.

EXPERIMENTAL FABRICATION

This facility includes sheet metal, welding and machining equipment capable of fabricating steel or aluminum hulls and turrets. The assembly area has high bays and heavy-duty cranes to handle vehicles up to 60-tons. The experimental foundry model and pattern shop, heat treating, plating and painting equipment complete the fabrication complex.

ELECTRO-MECHANICAL SYSTEMS

Additional facilities permit testing of engine accessories such as tank air cleaners, electrical equipment components, and mechanical and hydraulic subsystems.

Edited and coordinated by:
GLENN S. FINLEY, Technical Editor and
Project Officer for the Posture Report

Suggestions to improve this report are welcome. Request for Copies may be addressed to the US Army Tank-Automotive Command, ATTN: DRSTA-TS, Warren, MI 48090